STANDARD OPERATING PROCEDURE NO. 1

FIELD DOCUMENTATION

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities associated with the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). Appropriate documentation of field activities provides an accurate and comprehensive record of the work performed, sufficient for a technical peer to reconstruct the day's activities and determine that necessary requirements were met. Additional details are provided in the IWP.

This SOP may change depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this procedure, including:

- SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis;
- SOP No. 3 – Decontamination;
- SOP No. 4 – Tide Gage Installation;
- SOP No. 5 – Positioning;
- SOP No. 6 – Sediment Collection Using Hand Coring Device;
- SOP No. 7 – Sediment Collection Using Vibracoring Device;
- SOP No. 8 – Core Processing;
- SOP No. 9 – Management and Disposal of Residuals;
- SOP No. 10 – Bathymetric Surveying;
- SOP No. 11 – Sediment Collection Using Grab Sampling Device; and
- SOP No. 12 – Sediment Profile Imaging.

4.0 PROCEDURES

4.1 GENERAL REQUIREMENTS

Pertinent field information will be recorded in a logbook and/or an appropriate form (as described herein) in black, ballpoint pen. The field forms may be replaced with an electronic field database. A key that describes each entry is provided for each form. Logbook entries will be factual and observational (i.e., no speculation or opinion), and will not contain any personal information or non-project-related entries. Separate and dedicated logbooks will be kept for different operations running concurrently (e.g., core collection onboard the vessel, core processing at the Sample Processing Area); individual tasks making up each operation will be maintained in the same logbook, if possible. The cover and binding of each logbook will be labeled to identify the operation and dates included with the logbook; each page in the logbook will be consecutively numbered.

A page header will appear on the first page of each day's notes in the logbook, and activities for each day will be recorded on a new page. The page header will include:

- name of author and other personnel onsite (and affiliated organization if applicable);
- date;
- time of arrival; and
- current weather and tidal conditions, and weather forecast for the day.

An abbreviated header, limited to the date, will appear at the top of each additional page for the active date. Field forms (included in this SOP) will require similar header information.

Field activities and other events pertinent to the field activities will be documented in chronological order. Times will be recorded using Eastern Standard Time (EST) notation for each entry. At a minimum, documentation in a logbook will include the following:

- names of visitor(s) to the work location being documented in the log, including time of arrival and departure, the visitor's affiliation, and reason for visit;
- summary of project-related communications, including names of people involved and time;
- time daily work commences and ceases;
- start and stop times of new tasks;
- start and stop times of breaks;
- safety or other monitoring data, including units with each measurement;
- deviations from scope of work;
- progress updates;
- problems/delays encountered;

- unusual events; and
- signature or initials of author on every page.

A single line will be drawn through incorrect entries and the corrected entry written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.

If there are additional lines on the page at the end of the day's activities, a line will be drawn through the empty space, initialed, and dated, leaving no room for additional entries.

The logbook will cross-reference information documented in the field forms.

Photographs will be identified in the logbook by a unique numbering system. If photographs are collected by a digital camera, the file number as well as the photograph number will accompany the description of the photograph in the logbook. At a minimum, the time the photograph was taken, the general location, a brief description, and the photographer's name will be recorded. Additional information may include: Differential Global Positioning System (DGPS) coordinates, direction the photographer was facing, and/or weather conditions. If necessary, an object will be included to indicate the scale of the object in the photograph.

4.2 ADDITIONAL REQUIREMENTS FOR RIWP ACTIVITIES

This section presents specific documentation requirements for activities to be performed. It is meant to provide guidance to project staff responsible for field documentation during these activities, and is not intended to be a comprehensive list of activities performed. These documentation procedures are meant to supplement, not replace, the required documentation presented in Section 4.1.

As briefly described in Section 4.1, seven field forms were developed for the Phase I Sediment Investigation (Phase I SI) Program to ensure proper documentation of field information is obtained in a consistent manner. The purpose of each form is described below.

- Daily Activity Log – Provides a summary of daily vessel logistics during the Phase I SI activities including personnel present, equipment used, and weather conditions.

- Core Collection Form – Provides a summary of cores attempted and collected at each coring location.

- Individual Core Collection Form – Provides core-specific information such as penetration and recovery measured during core collection. The Individual Core Collection Form also serves as the chain of custody for the core as it is transported from the coring vessel to the Sample Processing Area.

- Grab Sample Collection Form – Provides a summary of grab sample information for each location including sample processing information for Beryllium-7.

- Core Lithology/Description Form – Provides a lithological description of a core observed during sample processing.

- Sample Processing Form – Provides core-specific information on sample segmentation and bulk density.

- Biologicially Active Zone (BAZ) Investigation Form – Provides a summary of information collection during the BAZ investigation including SPI deployment information (e.g., number of images collected) and the collection of grab samples.

4.2.1 EQUIPMENT DECONTAMINATION

Documentation of decontamination procedures will be contained in a logbook and include a list of equipment being decontaminated, a brief description of the procedure and materials used during the process, and the names of the project staff performing the decontamination. Documentation of QA samples (e.g., rinsate blanks), when collected, will include the information presented in Section 4.2.7.

4.2.2 EQUIPMENT CALIBRATION AND MAINTENANCE

Equipment calibration will be recorded in a logbook. Instrument information, including the instrument manufacturer, model number, and serial number, will be recorded. Instrument calibration will be performed in accordance with manufacturer's specifications and at the frequency specified in Table 6-10 of the IWP. Values measured during calibration will be recorded in the logbook. In addition, maintenance, problems, and repairs to the equipment will be recorded in the logbook. Equipment information, calibration, inspection, and maintenance will be documented in Table 6-9 of the IWP.

4.2.3 VESSEL POSITIONING

Information regarding vessel positioning will be recorded in the Daily Activity Logs, the Core Collection Forms, and the Individual Core Collection Forms, all of which are attached to this SOP.

4.2.4 BIOLOGICIALLY ACTIVE ZONE INVESTIGATION

Documentation of BAZ activities will be recorded in the BAZ Investigation Form. Additional information that should be entered into the logbook includes:

- names of the members of the BAZ crew;
- number of SPI and grab samples collected;
- processing procedures and equipment; and
- photograph number and description.

4.2.5 CORE COLLECTION

Documentation of core collection will be recorded in the Daily Activity Logs, the Core Collection Forms, and the Individual Core Collection Forms, all of which are attached to this SOP.

4.2.6 GRAB SAMPLE COLLECTION

Documentation of grab sample collection will be recorded in the Daily Activity Logs and Grab Sample Forms, both of which are attached to this SOP.

4.2.7 CORE PROCESSING

Documentation of core processing will be recorded in the Core Lithology/Description Form and Sample Processing Form, both of which are attached to this SOP. Additional information that should be considered for entry into the logbook includes:

- date and time (core processing and individual sample collection);
- names of the members of the processing crew;
- location ID;
- preservative (if necessary);
- processing procedures and equipment; and
- QA samples (matrix spike/matrix spike duplicate [MS/MSD] or MS/Duplicate) (if requested).

Sample information should be included in a logbook, as well as on the chain of custody form and sample container label.

4.2.8 SAMPLE HANDLING AND SHIPPING PROCEDURES

Activities associated with the handling and shipping of samples will be recorded in a logbook. In addition to meeting the general requirements presented in Section 4.1, sample handling and shipping documentation will include:

- date and time sample custody was relinquished;
- organization/representative receiving custody;
- name of analytical laboratory;
- tracking number (if using commercial shipping company); and
- Sample Delivery Group (SDG) Tracking Log number (for internal tracking purposes) (see Section 6.7 of the IWP for description of SDG).

4.3 DISTRIBUTION AND MAINTENANCE OF FIELD DOCUMENTATION

Logbooks, field forms, and chain of custody forms/SDG Tracking Logs will be filed according to the IWP.

Logbooks that are taken offsite from the field offices will be photocopied and filed at the end of each day to mitigate against the loss of historical entries should the logbook be lost in the field.

Field data forms and chain of custody/SDG Tracking Logs will be filed once they have been completed and distributed (if necessary), or at the end of each field day.

Distribution of daily forms will be performed according to the needs of the project team and at the direction of the FC or designee.

Upon completion of sampling and transfer of samples to the shipping company or courier, copies of the signed chains of custody and SDG Tracking Logs will be faxed to the FC, appropriate analytical laboratory contact, and the data validator. Copies of these documents will also be maintained at the field office in a labeled three-ring binder in reverse chronological order.

5.0 QUALITY ASSURANCE

Entries in the field forms (i.e., Daily Activity Log, the Core Collection Form, the Individual Core Collection Form, the Grab Sample Collection Form, the Core Lithology/Description Form, the Sample Processing Form, and the BAZ Investigation Form) will be double-checked by the samplers to verify the information is correct. Completed field forms will be reviewed periodically by the FC and/or Project Quality Assurance Officer or their designees to verify that the requirements are being met.

DAILY ACTIVITY LOG
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 2)

I.	Date: (1)			
II.	Vessel Name: (2)			
III.	Personnel (Name/Affiliation/Role): (3)			
IV.	Equipment on Board:	Name/Type	Model No.	Serial No.
	Coring Device:	(4)	(5)	(6)
	Grab Sample Device:			
	DGPS:			
	Fathometer:			
	SPI Camera:			
	Other:			
	Other:			
V.	Weather Forecast Checked?: Yes No (7)			
VI.	Time of High and Low Tide Checked? Yes No (8)			

DAILY ACTIVITY LOG
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 2)

I.	Date: (1)		
VII.	Health and Safety Briefing Topic: (9)		
VIII.	Notification:		
	Agency	Contact	Time (EST)
	(10)	(11)	(12)
	Vessel Tracking Service		
IX.	Time of Departure from Marina: (13) EST		
X.	Time of Return to Marina: (14) EST		
XI.	Name of Person Responsible for Log: (15)		

DAILY ACTIVITY LOG KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 1)

DESCRIPTION OF ITEMS:

(1) Date of activity (e.g., 1/1/2005).

(2) Name of vessel performing activity.

(3) Personnel on vessel, including name, affiliation, and role on the vessel.

(4) Name or type of equipment (e.g., for DGPS, enter Trimble); if specific equipment type not listed, enter under "Other."

(5) Model number of equipment (e.g., for DGPS, enter 7400).

(6) Serial number of equipment (if available).

(7) Weather forecast checked via marine radio, Newark Liberty International Airport, etc.

(8) Time of High and Low Tide for the day checked via NOAA/National Ocean Service's website.

(9) Significant topic(s) discussed at daily health and safety briefing.

(10) Name of Agency(ies) notified of daily activities.

(11) Agency(ies) contact name(s).

(12) Time that Agency(ies) was(were) contacted.

(13) Time of departure from the marina at the beginning of the day (EST).

(14) Time of return to the marina at the end of the day (EST).

(15) Name of person entering information into this form.

CORE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 2)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Location ID: (4)
III.	Geomorphic Area (circle one): (5) - Southern Navigation Channels (South of Port Newark) - Northern Navigation Channels (North of Port Newark) - Port Channels - Transitional Slopes - Sub-tidal Flats - Inter-tidal Areas - Industrial Waterfront Area
IV.	Geographic Description: (6)
V.	Weather at Time of Coring: - Wind Speed/Direction: (7) - Temperature: (8) - Precipitation: (9) - Cloud Cover: (10) - Sea State: (11)

CORE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 2)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Location ID: (4)
VI.	Cores Collected: (12)

Core ID (13)	Northing (ft) (14)	Easting (ft) (15)

VII.	Name of Person Responsible for Log: (16)

CORE COLLECTION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 1)

DESCRIPTION OF ITEMS:

(1) Date of coring (e.g., 1/1/2005).

(2) Start time of activities at location in EST.

(3) End time of activities at location in EST.

(4) Location ID (e.g., NB01SED030); refer to SOP No. 2, Section 4.2.1, for location identification code.

(5) Geomorphic area; circle appropriate.

(6) Geographic description of core location (e.g., Elizabeth Channel, North Newark Bay near Droyers Point).

(7) Wind speed and direction at time of core collection (e.g., 10-15 mph from NW).

(8) Air temperature at time of core collection (e.g., 68ºF).

(9) Precipitation at time of core collection (e.g., light rain).

(10) Cloud cover at time of core collection (e.g., partly cloudy).

(11) Sea state at time of core collection (e.g., 0-1 foot waves).

(12) Summary of cores collected at location.

(13) Core ID (e.g., NB01SED030B); refer to SOP No. 2, Section 4.2.1, for core identification code.

(14) Final Northing coordinate of core collection location in feet.

(15) Final Easting coordinate of core collection location in feet.

(16) Name of person entering information into this form.

INDIVIDUAL CORE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 4)

I.	Date: (1)
II.	Core ID: (2)
III.	Geomorphic Area (circle one): (3) - Southern Navigation Channels (South of Port Newark) - Northern Navigation Channels (North of Port Newark) - Port Channels - Transitional Slopes - Sub-tidal Flats - Inter-tidal Areas - Industrial Waterfront Area
IV.	Sediment Collection Method (circle one): (4) - Vibracoring - Hand Coring
V.	Coordinates: Target Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (5) - Easting (ft): (6) Final Positioning Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (7) - Easting (ft): (8) Confirm final core location coordinates are within 5 feet of target coordinates (9) Final Core Location Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (10) - Easting (ft): (11) Confirm final core location coordinates are within 50 feet of target coordinates (12)

INDIVIDUAL CORE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 4)

I.	Date: (1)
II.	Core ID: (2)
VI.	Water Depth at Time of Coring (ft): (13)
VII.	Start Time of Coring (EST): (14) End Time of Coring (EST): (15)
VIII.	Penetration: - Target Penetration (ft): (16) - Actual Penetration (ft): (17) - Penetration (%): (18) $\text{Penetration (\%)} = \frac{\text{Actual Penetration (feet)}}{\text{Target Penetration (feet)}} \times 100$ If Penetration (%) ≥ 75%, then penetration is acceptable. If Penetration (%) < 75%, then refer to either SOP No. 6, Section 4.2.3, or SOP No. 7, Section 4.2.3, depending on coring method. Refusal? (circle one): Yes No (19)
IX.	PID Reading: (20) **Breathing Zone Action Levels:** For total hydrocarbon levels >5 ppm, upgrade to Level C PPE. For total hydrocarbon levels >25 ppm, stop work. For hydrogen sulfide levels >5 ppm, stop work, evacuate work area, and ventilate.

INDIVIDUAL CORE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 3 of 4)

I.	Date: (1)
II.	Core ID: (2)
X.	Recovery: - Recovery (ft): (21) - Recovery (%): (22) $\text{Recovery (\%)} = \frac{\text{Recovery (ft)} - \text{Gaps (ft)}}{\text{Actual Penetration (ft)}} \times 100$ - Gaps Identified (23) If Recovery (%) ≥ 75%, then recovery is acceptable. If Recovery (%) < 75%, then refer to either SOP No. 6, Section 4.2.3, or SOP No. 7, Section 4.2.3, depending on coring method.
XI.	Final Disposition of Core (circle one): (24) - Retained for Processing - Rejected If rejected, reason for rejection: (25)

INDIVIDUAL CORE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 4 of 4)

I.	Date: (1)
II.	Core ID: (2)
XII.	Notes (see logbook for additional information): (26)
XIII.	Name of Person Responsible for Log: (27)

Relinquished By (28) Company (29) Date (30) Time (31)
Accepted By (32) Company (33) Date (34) Time (35)

Relinquished By _____ Company _____ Date _____ Time _____
Accepted By _____ Company _____ Date _____ Time _____

INDIVIDUAL CORE COLLECTION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 2)

DESCRIPTION OF ITEMS:

(1) Date of coring (e.g., 1/1/2005).

(2) Core ID (e.g., NB01SED030B); refer to SOP No. 2, Section 4.2.1, for core identification code.

(3) Geomorphic area; circle appropriate.

(4) Sediment collection method used (e.g., vibracoring or hand coring).

(5) Target Northing coordinate in feet from Table 6-3 of IWP.

(6) Target Easting coordinate in feet from Table 6-3 of IWP.

(7) Final Position Northing coordinate in feet.

(8) Final Position Easting coordinate in feet.

(9) Confirm the final position location is within 5 feet of the target location; refer to SOP No. 5, Section 4.2.

(10) Final Northing coordinate of core collection location in feet. This location may be different than (5) due to the adjustment of vessel position for multiple core attempts at the same location (refer to SOP No. 5, Section 4.2.2).

(11) Final Easting coordinate of core collection location in feet. This location may be different than (6) due to the adjustment of vessel position for multiple core attempts at the same location (refer to SOP No. 5, Section 4.2.2).

(12) Confirm the final location is within 50 feet of the target location; refer to SOP No. 5, Section 4.2.

(13) Water depth at core collection location in feet.

(14) Time core collection with vibracoring or hand coring device is started in EST.

(15) Time core collection with vibracoring or hand coring device is finished in EST.

(16) Target penetration in feet with vibracoring or hand coring device; from Table 6-3 of IWP.

(17) Actual penetration of core into sediment. Actual penetration is the depth advanced into the sediment not including the depth advanced to form a sediment "plug."

Actual penetration (ft) = Penetration (ft) – "plug" (ft)

INDIVIDUAL CORE COLLECTION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 2)

(18) Penetration (%) - calculated according to formula on form.

(19) If penetration < 75%, indicate if refusal was encountered.

(20) PID reading in the breathing zone upon screening core; action levels from Section 6.4 of the HASCP.

(21) Recovery (ft) = sediment length in core. To identify gaps, visually inspect the core for signs of separation of the sediments within the core, smears on the polybutyrate core tube walls or a water layer within the sediments. Measure the distance between the top and bottom of these interfaces to obtain the length(s) of the gap(s).

(22) Recovery (%) = sediment length in core per actual penetration.

(23) Record any gaps identified. Record approximate location (feet below the sediment surface) and the size of the gap (feet). For example, "0.1 foot gap observed at 1.5 feet below sediment surface."

(24) Final disposition of core (e.g., retained for processing or rejected).

(25) Provide explanation for rejecting core (e.g., recovery < 75%).

(26) Provide notes pertinent to core collection (e.g., aborted core collection due to weather); additional details may be provided in logbook.

(27) Name of person entering information into this form.

(28) Name of personnel relinquishing core.

(29) Company affiliation of personnel relinquishing core.

(30) Date core is relinquished.

(31) Time core is relinquished.

(32) Name of personnel accepting core.

(33) Company affiliation of personnel accepting core.

(34) Date core is accepted.

(35) Time core is accepted.

GRAB SAMPLE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Grab Sample ID: (4)
III.	Geomorphic Area (circle one): (5) - Northern Navigation Channels (North of Port Newark) - Transitional Slopes - Sub-tidal Flats - Inter-tidal Areas - Industrial Waterfront Area
IV.	Geographic Description: (6)
V.	Weather at Time of Grab Sample: - Wind Speed/Direction: (7) - Temperature: (8) - Precipitation: (9) - Cloud Cover: (10) - Sea State: (11)

GRAB SAMPLE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Grab Sample ID: (4)
VI.	Coordinates: Target Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (12) - Easting (ft): (13) Final Positioning Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (14) - Easting (ft): (15) Confirm final grab sample location coordinates are within 5 feet of target coordinates (16) Final Grab Sample Coordinates (New Jersey State Plane NAD 83) - Northing (ft): (17) - Easting (ft): (18) Confirm final grab sample location coordinates are within 50 feet of target coordinates (19)
VII.	Water Depth at Time of Grab Sampling (ft): (20)
VIII.	Time of Grab Sample Collection (EST): (21)
IX.	Grab Collection: Adequate collection to meet sample requirements? (circle one): Yes No (22)

GRAB SAMPLE COLLECTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 3 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Grab Sample ID: (4)
X.	Notes (see logbook for additional information): (23)
XI.	[7]Be Processing: (24) Sample ID: (25) Sample Date: (26) Sample Time (27)
XII.	Name of Person Responsible for Log: (28)

GRAB SAMPLE COLLECTION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 2)

DESCRIPTION OF ITEMS:

(1) Date of grab sampling (e.g., 1/1/2005).

(2) Start of grab sample collection activities.

(3) End of grab sample collection activities.

(4) Grab Sample ID (e.g., NB01SED037A); refer to SOP No. 2, Section 4.2.1, for identification code.

(5) Geomorphic area; circle appropriate.

(6) Geographic description of core location (e.g., North Newark Bay near Droyers Point).

(7) Wind speed and direction at time of core collection (e.g., 10-15 mph from NW).

(8) Air temperature at time of grab sample collection (e.g., 68ºF).

(9) Precipitation at time of grab sample collection (e.g., light rain).

(10) Cloud cover at time of grab sample collection (e.g., partly cloudy).

(11) Sea state at time of grab sample collection (e.g., 0-1 foot waves).

(12) Target Northing coordinate in feet from Table 6-3 of IWP.

(13) Target Easting coordinate in feet from Table 6-3 of IWP.

(14) Final Position Northing coordinate in feet.

(15) Final Position Easting coordinate in feet.

(16) Confirm the final position location is within 5 feet of the target location; refer to SOP No. 5, Section 4.2.

(17) Final Northing coordinate of grab sample location in feet. This location may be different than (12) due to the adjustment of vessel position for multiple grab sample attempts at the same location (refer to SOP No. 5, Section 4.2.2).

(18) Final Easting coordinate of grab sample location in feet. This location may be different than (13) due to the adjustment of vessel position for multiple grab sample attempts at the same location (refer to SOP No. 5, Section 4.2.2).

GRAB SAMPLE COLLECTION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 2)

(19) Confirm the final location is within 50 feet of the target location; refer to SOP No. 5, Section 4.2.

(20) Water depth at grab sample collection in feet.

(21) Time of grab sample collection in EST.

(22) Indicate whether sufficient sediment was obtained to fill the sample container.

(23) Provide notes pertinent to grab sample collection (e.g., aborted grab sample collection due to weather); additional details may be provided in logbook.

(24) Beryllium-7 will be processed on the sampling/coring vessel in accordance with SOP No. 11 – Sediment Collection Using Grab Sampling Device.

(25) Sample ID (e.g., NB01SED037A-01); refer to SOP No. 2, Section 4.2.1, for sample identification code.

(26) Date sample was collected (e.g., 1/1/2005).

(27) Time sample was collected in EST.

(28) Name of person entering information into this form.

CORE LITHOLOGY/DESCRIPTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 2)

Date of Core Collection: (1) (from Individual Core Collection Form)

Date of Core Processing: (2)

Core ID: (3) (from Individual Core Collection Form)

Geomorphic Area (circle one): (4) (from Individual Core Collection Form)

- Southern Navigation Channels (South of Port Newark)
- Northern Navigation Channels (North of Port Newark)
- Port Channels
- Transitional Slopes
- Sub-tidal Flats
- Inter-tidal Areas
- Industrial Waterfront Area

Geographic Description: (5) (from Individual Core Collection Form)

Coordinate Northing (ft, NAD83): (6) (from Individual Core Collection Form)

Coordinate Easting (ft, NAD83): (7) (from Individual Core Collection Form)

Name of Person Responsible for Log: (8)

CORE LITHOLOGY/DESCRIPTION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 2)

Date of Core Collection: (1) Date of Core Processing: (2)
Core ID: (3)

Breathing Zone Action Levels:
For total hydrocarbon levels >5 ppm, upgrade to Level C PPE.
For total hydrocarbon levels >25 ppm, stop work.
For hydrogen sulfide levels >5 ppm, stop work, evacuate work area, and ventilate.

Depth (Feet Below Sediment Surface in Core)	PID Screening (ppm)	Description	Engineer's/Geologist's Notes
(9)	(10)	(11)	(12)
-1 - -2 - -3 - -4 - -5 - -6 - -7 - -8 - -9 - -10 - -11 - -12			

CORE LITHOLOGY/DESCRIPTION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 1)

DESCRIPTION OF ITEMS:

(1) Date of core collection (taken from the Individual Core Collection Form).

(2) Date of core processing (e.g., 1/1/2005).

(3) Core ID (e.g., NB01SED030B) (taken from the Individual Core Collection Form).

(4) One of the seven geomorphic areas (taken from the Individual Core Collection Form).

(5) Geographic description of core location (e.g., Elizabeth Channel, North Newark Bay near Droyers Point) (taken from the Individual Core Collection Form).

(6) Northing coordinate in feet of core collection location (taken from the Individual Core Collection Form).

(7) Easting coordinate in feet of core collection location (taken from the Individual Core Collection Form).

(8) Name of person entering information into this form.

(9) Depth (feet below the sediment surface) of change in lithology and USCS description identified during logging. The procedures on how to describe the sediment core are provided in SOP No. 8.

(10) PID reading in ppm for the breathing zone above the interval screened (e.g., 6 ppm); action levels from Section 6.4 of HASCP.

(11) Description of soil type using the USCS. The procedure of how to describe the sediment core is provided in SOP No. 8.

(12) Provide notes pertinent to the sample description (e.g., 1" gap observed in this interval) for a given lithological interval.

SAMPLE PROCESSING FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 3)

Date of Core Collection: (1) (from Individual Core Collection Form)

Date of Core Processing: (2)

Core ID: (3) (from Individual Core Collection Form)

Geomorphic Area (circle one): (4) (from Individual Core Collection Form)

- Southern Navigation Channels (South of Port Newark)
- Northern Navigation Channels (North of Port Newark)
- Port Channels
- Transitional Slopes
- Sub-tidal Flats
- Inter-tidal Areas
- Industrial Waterfront Area

Geographic Description: (5) (from Individual Core Collection Form)

Primary Core: (6)
Coordinate Northing (ft, NAD83): (7) (from Individual Core Collection Form)

Coordinate Easting (ft, NAD83): (8) (from Individual Core Collection Form)

Actual Penetration (ft): (9) (from Individual Core Collection Form)

Recovery (ft) During Core Collection: (10) (from Individual Core Collection Form)

Recovery (%) During Core Collection: (11) (from Individual Core Collection Form)

Recovery (ft) During Core Processing: (12)

Recovery (%) During Core Processing: (13)

$$\text{Recovery (\%) During Core Processing} = \frac{\text{Recovery (ft) During Core Processing - Gaps (ft)}}{\text{Actual Penetration (ft)}} \times 100$$

SAMPLE PROCESSING FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 3)

BAZ Core: (14)

Coordinate Northing (ft, NAD83): (15) (from Individual Core Collection Form)

Coordinate Easting (ft, NAD83): (16) (from Individual Core Collection Form)

Actual Penetration (ft): (17) (from Individual Core Collection Form)

Recovery (ft) During Core Collection: (18) (from Individual Core Collection Form)

Recovery (%) During Core Collection: (19) (from Individual Core Collection Form)

Recovery (ft) During Core Processing: (20)

Recovery (%) During Core Processing: (21)

$$\text{Recovery (\%) During Core Processing} = \frac{\text{Recovery (ft) During Core Processing} - \text{Gaps (ft)}}{\text{Actual Penetration (ft)}} \times 100$$

Bulk Density:

Area of core tube (ft^2): 0.067 (22)

Average weight of unit length of core tube (g/ft): (23)

Average weight cap (g): (24)

Length of sediment (subtract length of gaps) (ft): (25)

Weight of sediment and tube (g): (26)

Bulk density of sediment (g/cm^3): (27)

$$r_{bulk} = \frac{W_{sediment}}{A_{tube} * L_{sediment}} = \frac{W_{sed\&tube} - W_{tube} - W_{caps}}{A_{tube} * L_{sediment} * 30.48 \frac{cm^3}{ft^3}}$$

Name of Person Responsible for Log: (28)

SAMPLE PROCESSING FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 3 of 3)

Date of Core Collection: _____ (1) _____ (from Individual Core Collection Form)
Date of Core Processing: _____ (2) _____
Core ID: _____ (3) _____ (from Individual Core Collection Form)

Sample ID (29)	Sample Time (EST) (30)	Sample Interval (ft) (31)		Sample Submitted for Following Analyses (32)														
		Top	Bottom	Volatile Organics	PCDDs/PCDFs	PCB Congeners and	Pesticides and Aroclors PCBs	Semivolatile Organics	Mercury	Inorganics	Herbicides	Cyanide	TEPH	TOC	Percent Moisture	Grain Size	Comments (33)

SAMPLE PROCESSING FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 2)

DESCRIPTION OF ITEMS:

(1) Date of core collection (taken from the Individual Core Collection Form).

(2) Date of core processing (e.g., 1/1/2005).

(3) Core ID (e.g., NB01SED030B) (this is taken from the Individual Core Collection Form).

(4) One of the seven geomorphic areas (taken from the Individual Core Collection Form).

(5) Geographic description of the core location (e.g., Elizabeth Channel, North Newark Bay near Droyers Point) (taken from the Individual Core Collection Form).

(6) The primary core is the core containing all sample depths.

(7) Northing coordinate in feet of core collection location (taken from Individual Core Collection Form).

(8) Easting coordinate in feet of core collection location (taken from Individual Core Collection Form).

(9) Actual penetration of core into sediment (taken from the Individual Core Collection Form).

(10) Recovery (ft) at time of core collection = sediment length in core at the time of core collection (taken from the Individual Core Collection Form).

(11) Recovery (%) at time of core collection = sediment length at the time of core collection in core per actual penetration (taken from the Individual Core Collection Form).

(12) Recovery (ft) at time of core processing = sediment length in core at the time of processing. Note: the length of sediment in the core and the recovery may be different than listed on the Individual Core Collection Form due to additional consolidation of sediments within the core between the time cored and time processed.

(13) Recovery (%) during core processing = sediment length at the time of processing per actual penetration.

(14) The BAZ core is the core collected for the purpose of providing additional sample volume for the 0 - 0.5-foot BAZ sediment sample.

(15) Northing coordinate in feet of core collection location (taken from Individual Core Collection Form).

(16) Easting coordinate in feet of core collection location (taken from Individual Core Collection Form).

SAMPLE PROCESSING FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 2)

(17) Actual penetration of core into sediment (taken from the Individual Core Collection Form).

(18) Recovery (ft) at time of core collection = sediment length in core at the time of core collection (taken from the Individual Core Collection Form).

(19) Recovery (%) at time of core collection = sediment length at the time of core collection in core per actual penetration (taken from the Individual Core Collection Form).

(20) Recovery (ft) at time of core processing = sediment length in core at the time of processing.

(21) Recovery (%) at time of core processing = sediment length at the time of processing per penetration.

(22) Cross-sectional area of the inside of the core tube in ft^2. When using a 4-inch outer diameter core tube, a 3.5-inch inner diameter core tube has a cross-sectional area of 0.067 ft^2.

(23) Average weight of unit length of core tube (i.e., grams per linear foot) in grams; refer to SOP No. 8, Section 4.2.3, for procedures to determine an average weight of unit length.

(24) Average weight of caps in grams; refer to SOP No. 8, Section 4.2.3, for procedures to determine an average weight of caps.

(25) Length of sediment in the core tube (minus the length of gaps) in feet.

(26) Weight of sediment and core tube in grams.

(27) Bulk density of sediment in g/cm^3; calculated according to formula on form.

(28) Name of person entering information into this form.

(29) Sample ID (e.g., NB01SED030B-02); refer to SOP No. 2, Section 4.2.1, for sample identification code.

(30) Time sample was removed from core in EST.

(31) Sample interval = target sample interval depths multiplied by Recovery (%) at time of core processing. For example, if target sample interval is 0.5 - 1.5 feet and the Recovery (%) at time of core processing is 80%, then the sample interval would be 0.4 - 1.2 feet.

(32) Check the boxes for which analyses the sample is being submitted.

(33) Provide any pertinent comments regarding the sediment sample submitted for analyses (e.g., not enough sample volume; therefore, TEPH and TOC not requested for analysis).

BAZ INVESTIGATION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 3)

I.	Date: (1) Start Time: (2) End Time: (3)
II.	Location ID: (4)
III.	Geomorphic Area (circle one): (5) - Southern Navigation Channels (South of Port Newark) - Northern Navigation Channels (North of Port Newark) - Sub-tidal Flats - Inter-tidal Areas
IV.	Geographic Description: (6)
V.	Weather While on Location: - Wind Speed/Direction: (7) - Temperature: (8) - Precipitation: (9) - Cloud Cover: (10) - Sea State: (11)

BAZ INVESTIGATION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 3)

I. Date: (1) Start Time: (2) End Time: (3)

II. Location ID: (4)

VI. SPI Coordinates: (12)

SPI Location ID	Target Coordinates (New Jersey State Plane NAD83)		Final Positioning Coordinates (New Jersey State Plane NAD83)		Confirm Final Position w/in 5 ft
	Northing (ft)	Easting (ft)	Northing (ft)	Easting (ft)	
(13)	(14)	(15)	(16)	(17)	(18)

SPI Location ID	Final SPI Coordinates (New Jersey State Plane NAD83)		Water Depth at SPI Location (ft)
	Northing (ft)	Easting (ft)	
(13)	(19)	(20)	(21)

VII. SPI Collection: (22)

SPI Location ID	Depth of Deployment	Start Time	End Time	Number of Images	Check on Image Clarity
(23)	(24)	(25)	(26)	(27)	(28)

BAZ INVESTIGATION FORM
PHASE I SEDIMENT INVESTIGATION
(Sheet 3 of 3)

I. Date: (1) Start Time: (2) End Time: (3)

II. Location ID: (4)

VIII. Grab Sample Coordinates: (29)

Grab Sample Location ID	Target Coordinates (New Jersey State Plane NAD83)		Final Positioning Coordinates (New Jersey State Plane NAD83)		Confirm Final Position w/in 5 ft
	Northing (ft)	Easting (ft)	Northing (ft)	Easting (ft)	
(30)	(31)	(32)	(33)	(34)	(35)

Grab Sample Location ID	Final SPI Coordinates (New Jersey State Plane NAD83)		Water Depth at SPI Location (ft)
	Northing (ft)	Easting (ft)	
(30)	(36)	(37)	(38)

IX. Grab Sample Collection: (39)

Grab Sample Location ID	Sample Description	Benthic Invertebrate Activity
(40)	(41)	(42)

X. Name of Person Responsible for Log: (43)

BAZ INVESTIGATION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 1 of 3)

DESCRIPTION OF ITEMS:

(1) Date of BAZ activities (e.g., 1/1/2005)

(2) Start time of BAZ activities at location in EST.

(3) End time of BAZ activities at location in EST.

(4) Location ID (e.g., NB01SED030); refer to SOP No. 2, Section 4.2.1, for location identification code.

(5) Geomorphic area; circle appropriate.

(6) Geographic description of BAZ location (e.g., North Newark Bay near Droyers Point).

(7) Wind speed and direction at time of BAZ activities (e.g., 10-15 mph from NW).

(8) Air temperature at time of BAZ activities (e.g., 68ºF).

(9) Precipitation at time of BAZ activities (e.g., light rain).

(10) Cloud cover at time of BAZ activities (e.g., partly cloudy).

(11) Sea state at time of BAZ activities (e.g., 0-1 foot waves).

(12) SPI coordinates table provides target coordinates, final positioning coordinates, and final SPI coordinates for each SPI deployment at the BAZ location. A minimum of two SPI deployments will be conducted at each BAZ location.

(13) SPI Location ID (e.g., NB01SED030-1); each deployment of the camera at a BAZ location will be designated by an increasing number (e.g., 1, 2, 3).

(14) Target Northing coordinate in feet from Table 6-3 of IWP.

(15) Target Easting coordinate in feet from Table 6-3 of IWP.

(16) Final Position Northing coordinate in feet.

(17) Final Position Easting coordinate in feet.

(18) Confirm the final position is within 5 feet of the target location; refer to SOP No. 5, Section 4.2.

(19) Final Northing coordinate of SPI location in feet. This location may be different than (14) due to the adjustment of vessel position for multiple SPI attempts at the same location (refer to SOP No. 5, Section 4.2.2).

BAZ INVESTIGATION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 2 of 3)

(20) Final Easting coordinate of SPI location in feet. This location may be different than (15) due to the adjustment of vessel position for multiple SPI attempts at the same location (refer to SOP No. 5, Section 4.2.2).

(21) Confirm the final location is within 50 feet of the target location; refer to SOP No. 5, Section 4.2.

(22) Water depth at time of SPI deployment in feet.

(23) SPI collection table provides the information pertaining to SPI activities (e.g., depth of deployment, start and end time of imaging, number of images collected).

(24) SPI location ID (e.g., NB01SED030-1); each deployment of the camera at a BAZ location will be designated by an increasing number (e.g., 1, 2, 3). These SPI location IDs correspond with the SPI coordinates (see description 12).

(25) Start time of SPI deployment in EST.

(26) End time of SPI deployment in EST.

(27) Number of images that are collected at the SPI deployment.

(28) Confirm clarity of the images for BAZ analysis. If images are not clear, additional deployments will be necessary.

(29) Grab sample coordinates table provides target coordinates, final positioning coordinates, and final coordinates for grab sample locations. A minimum of three grab samples will be collected at each BAZ location.

(30) Grab sample location ID (e.g., NB01SED030-1); each deployment of the grab sampler at a BAZ location will be designated by an increasing number (e.g., 1, 2, 3).

(31) Target Northing coordinate in feet from Table 6-3 of IWP.

(32) Target Easting coordinate in feet from Table 6-3 of IWP.

(33) Final Position Northing coordinate in feet.

(34) Final Position Easting coordinate in feet.

(35) Confirm the final position is within 5 feet of the target location; refer to SOP No. 5, Section 4.2.

(36) Final Northing coordinate of grab sample location in feet. This location may be different than (31) due to the adjustment of vessel position for multiple grab sample attempts at the same location (refer to SOP No. 5, Section 4.2.2).

BAZ INVESTIGATION FORM KEY
PHASE I SEDIMENT INVESTIGATION
(Sheet 3 of 3)

(37) Final Easting coordinate of grab sample location in feet. This location may be different than (32) due to the adjustment of vessel position for multiple grab sample attempts at the same location (refer to SOP No. 5, Section 4.2.2).

(38) Confirm the final location is within 50 feet of the target location; refer to SOP No. 5, Section 4.2.

(39) Water depth at time of grab sample collection in feet.

(40) Grab sample location ID (e.g., NB01SED030-1); each deployment of the grab sampler at a BAZ location will be designated by an increasing number (e.g., 1, 2, 3). These grab sample location IDs correspond with the grab sample coordinates (see description 29).

(41) Sediment description of soil type using the USCS.

(42) Description of benthic invertebrates present in grab sample.

(43) Name of person entering information into this form.

STANDARD OPERATING PROCEDURE NO. 2

CONTAINERS, PRESERVATION, HANDLING, AND TRACKING OF SAMPLES FOR ANALYSIS

2.0 TABLE OF CONTENTS

ATTACHMENTS

PREPRINTED SAMPLE LABEL
CHAIN OF CUSTODY FORM
SDG TRACKING LOG

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for containerizing, preserving, handling, tracking, and shipping samples collected as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). Samples may include sediment collected or generated for chemical analysis, radiochemical analysis, and associated quality assurance (QA) analysis. This SOP is intended to be complete enough so that 1) the steps which could affect tracking, documentation, or integrity of samples are explained in sufficient detail and 2) different sampling personnel following these procedures will deliver samples to the laboratory which are equally reliable and consistent, and in compliance with regulatory agency requirements. Specific information regarding sample collection and analysis is found in the IWP.

This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Field Documentation;
- SOP No. 6 – Sediment Collection Using Hand Coring Device;
- SOP No. 7 – Sediment Collection Using Vibracoring Device;
- SOP No. 8 – Core Processing;
- SOP No. 9 – Management and Disposal of Residuals; and
- SOP No. 10 – Sediment Collection Using Grab Sampling Device.

4.0 PROCEDURES

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- inert packing material (e.g., foam peanuts, vermiculite, cardboard, etc.);
- colorimetric pH test paper;
- nitric acid (HNO_3) and pipette;
- sample containers as specified in Tables 6-6 and 6-7 of the IWP;
- sample labels;
- chain of custody;
- Sample Delivery Group (SDG) Tracking Logs;
- ice chest(s);
- custody seals;
- indelible marking pens;
- shipping tape;
- sealable plastic bags;
- temperature blanks (if not provided by the laboratory);
- logbook;
- ice or similar chilling source;
- potassium iodide starch paper;
- spatula;
- sodium hydroxide (NaOH) and pipette;
- plastic lining material; and
- clear tape.

4.2 SAMPLE IDENTIFICATION AND LABELING

4.2.1 SAMPLE IDENTIFICATION CODE

The standard sample identification number will consist of a unique 13 character string used to identify each sample collected and submitted to the laboratories for analysis, as follows:

Characters 1 and 2: Two characters to describe the waterbody where the sample was collected. For the Phase I SI Program, this will be "NB" for Newark Bay or "HR" for Hackensack River.

Characters 3 and 4: Two digits to describe the phase during which the sample was collected. For example, the Phase I SI Program will be described as "01".

Characters 5, 6, and 7: Three characters to describe the sample matrix. For the Phase I SI Program, this will be "SED" for sediment. Duplicate samples will be identified in a logbook and transferred to the database.

Characters 8, 9, and 10: A three digit number to describe the sample collection location (sequentially numbered from 001 to 999).

Character 11: A character which describes the sequence of cores or grabs collected at this location (A, B, C…).

Character 12 and 13: A two digit number (preceded by a hyphen) to describe the sample collected at that location, sequentially numbered from 01 to 99, beginning at the top of the core and proceeding down.

<u>Location Identifier</u>

Location IDs are pre-assigned and are found on Table 6-3 of the IWP. The location ID and location information (coordinates) will be recorded on the Individual Core Collection Form, the Core Lithology/Description Form, and the Sample Processing Form (see SOP No. 1 – Field Documentation).

Sample Identifier

The sample identifier is represented by Characters 12 and 13. For sediment samples collected from cores, the first interval to be sampled for chemical analyses, starting from the top of the core, will be assigned a sample number 01, and each subsequent interval sampled, with increasing depth, will be assigned the next higher sequential sample number (e.g., 02, 03, etc.)

Example of Sample Identification Code

Following is an example of a sediment core segment identification number:

NB01SED030B-02

Explanations:

- The sample was collected in Newark Bay during the Phase I SI Program and was a sediment sample.
- The sample was collected at Location 30 from the second core at that location.
- The sample represents the second interval sampled for analysis, referenced to the top of the core.

4.2.2 SAMPLE DELIVERY GROUP (SDG) NUMBER IDENTIFICATION CODE

The standard SDG Number will consist of a unique six character string used to identify each SDG submitted to the laboratories for analysis, as follows:

Characters 1 and 2:	Two characters to describe the water body where the samples were collected. For the Phase I SI Program, this will be "NB" for Newark Bay.
Character 3:	One digit to describe the phase during which the sample was collected. For example, the Phase I SI Program will be described as "1".
Characters 4 through 6:	A three digit number to describe the SDG, sequentially numbered beginning with 001, up to 999.

Following is an example of a SDG Number:

NB1003

Explanation:

The samples in this SDG were collected from Newark Bay during the Phase I SI Program. The SDG was the third SDG submitted to the laboratory for analysis.

4.2.3 QUALITY ASSURANCE SAMPLE IDENTIFICATION CODE

Rinsate blank samples will be labeled by a unique eight character string. The first six characters will be the SDG Number that the rinsate blank is being submitted with. The last two characters will be "RB" for rinsate blank.

Following is an example of a SDG Number:

NB1003RB

Explanation:

This rinsate blank was submitted along with samples collected from Newark Bay during the Phase I SI Program with the third SDG.

4.2.4 SAMPLE LABELING

A label will be attached to each bottle used for sampling. An example of a preprinted sample label is attached to this SOP. When practical, the project number, sample matrix, laboratory designation, and sample identification code will be typed or printed onto the label before sampling. Once affixed to the sample container, the label will be protected from water and solvents with clear packing tape.

4.3 SAMPLE CONTAINERS AND PRESERVATION

4.3.1 SAMPLE CONTAINERS

To ensure that the appropriate sample quantities are collected in certified, pre-cleaned containers, sample containers for this project will be supplied from commercial suppliers or laboratories. Sample containers will be cleaned to the quality control standard defined in USEPA Office of Solid Waste and Emergency Response (OSWER) Directive #9240.0-05A. Certification of sample container quality per the OSWER directive will be kept in the Newark Bay Central Project File. Tables 6-6 and 6-7 of the IWP summarize container types which will be provided for samples collected.

4.3.2 SAMPLE PRESERVATION

The contracted laboratory performing the analysis will provide certified, pre-cleaned containers containing a pre-determined amount of the required preservative(s) for rinsate blanks, as appropriate. In cases where field adjustment of pH is necessary, the procedures outlined below will be followed for the appropriate analysis. Sample containers for sediment will not contain preservatives.

The rinsate blank sample containers will be pre-preserved by the laboratory. The specific preservatives to be used for each chemical analysis are summarized in Tables 6-6 and 6-7 of the IWP. Documentation of equipment and methods used in preservation, and field-adjustment of pH will be maintained in a logbook. The chemicals and amounts used will be recorded. If refrigeration is necessary, samples will be placed on ice after collection, and shipping containers will be packed with additional ice, if needed, prior to shipment via overnight carrier.

4.3.2.1 pH FOR RINSATE BLANKS FOR CYANIDE ANALYSIS

Aqueous rinsate blank sample bottles for cyanide analysis will be pre-preserved with NaOH. Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is less than 12, increase the pH of the rinsate blank by adding 50% NaOH. Using a pipette, add 0.2 ml (4 to 5 drops) of NaOH to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (greater than 12) is achieved. The aliquots used for testing the pH will be disposed in accordance with SOP No. 9 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

4.3.2.2 pH FOR RINSATE BLANKS FOR METALS ANALYSIS

Aqueous rinsate blank sample bottles for metals analysis will be preserved with HNO_3. Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is greater than 2, lower the pH of the rinsate blank by adding HNO_3. Using a pipette add 0.2 ml (4 to 5 drops) of HNO_3 to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (less than 2) is achieved.

The separate aliquots used for testing the pH will be disposed in accordance with SOP No. 9 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

4.3.2.3 pH FOR RINSATE BLANKS FOR TOC ANALYSIS

Aqueous rinsate blank sample bottles for TOC analysis will be preserved with H_2SO_4. Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is greater than 2, lower the pH of the rinsate blank by adding H_2SO_4. Using a pipette add 0.2 ml (4 to 5 drops) of H_2SO_4 to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (less than 2) is achieved.

The separate aliquots used for testing the pH will be disposed in accordance with SOP No. 9 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

4.3.2.4 pH FOR RINSATE BLANKS FOR TEPH ANALYSIS

Aqueous rinsate blank sample bottles for TEPH analysis will be preserved with HCl. Immediately following sample collection, the pH of the preserved sample will be determined and adjusted, if necessary, using the following procedure:

1. Close the bottle and gently invert it several times to mix the preservative with the sample.

2. Pour a small aliquot (a few drops) of the sample into a separate vial.

3. Test the aliquot in the vial with colorimetric pH paper appropriate to the pH being tested. If the pH of the sample is greater than 2, lower the pH of the rinsate blank by adding HCl. Using a pipette add 0.2 ml (4 to 5 drops) of HCl to the sample.

4. Close the bottle and gently invert it several times to mix the preservative with the sample.

5. Pour a small aliquot (a few drops) of the sample into a separate vial.

6. Repeat this process until the correct pH (less than 2) is achieved.

The separate aliquots used for testing the pH will be disposed in accordance with SOP No. 9 – Management and Disposal of Residuals. The amount, type, and procedures will be documented in the logbook in accordance with SOP No. 1 – Field Documentation.

4.3.2.5 PREPARATION OF pH FOR RINSATE BLANKS FOR VOC ANALYSIS

Aqueous rinsate blank sample bottles for VOC analysis will be pre-preserved with sufficient HCl to lower the rinsate blank below a pH of 2. Rinsate blanks for VOC analyses will be prepared using the following procedure:

1. Slowly pour rinsate blank into pre-prepared VOC vial until a meniscus is formed on the top of the vial.

2. Carefully cap the VOC vial and gently invert the vial to check for air bubbles.

3. Repeat process until no air bubbles are present. Dispose of VOC samples with air bubbles in accordance with SOP No. 9 – Management and Disposal of Residuals.

4.4 SAMPLE HANDLING AND SHIPPING

Sample packaging and shipping will be done in accordance with applicable regulations, as described below.

1. After filling a sample container, affix cap and securely seal with clear tape (except for samples to be analyzed for VOCs) and complete the sample label. Apply the label to the sample container and cover with clear tape.

2. Clean the outside of each sample container by wiping it off with a clean paper towel. Verify that residual sediment has been removed from the outside of the container, and from the area under and around the cap.

3. Seal each sample container inside a sealable plastic bag. Samples for VOC analysis will be packaged together in a sealed plastic bag.

4. Place samples on ice or similar chilling source immediately after collection.

5. Transfer the samples to a plastic-lined ice chest which will be used as a shipping container. Use inert packaging material (e.g., cardboard, vermiculite, etc.) to cushion the samples and minimize the potential for breakage. Seal the drains on the ice chest (if present) with shipping tape or plug the drains with silicone sealant or a similar inert substance.

6. Ice chests will contain ice or similar chilling sources sufficient to maintain a temperature of 4° Celsius (°C) inside the cooler during transport. Use sufficient ice to accommodate reasonable delays in shipment. A temperature blank provided by the analytical laboratory with each cooler will be included in the shipment.

7. Complete sample tracking documentation as described in Section 4.5 of this SOP, and place the documents in a sealable plastic bag inside the ice chest, taped to the inside of the lid. Prior to sealing for shipment, check the list of samples against the container contents to verify the presence of each sample listed on the chain of custody.

8. Secure chest lid with shipping tape by covering the entire seal with tape. Complete information on the custody seal and affix the custody seal over the taped seal.

9. Transport the shipping container directly to the laboratory, the laboratory courier, or to the overnight carrier for overnight delivery. Once a core has been opened, sediment samples will be shipped by close of the following day. Rinsate blank samples will also be shipped by close of the following day with the appropriate SDG.

4.5 SAMPLE TRACKING

From the time of collection through transportation, the handling of samples will follow chain of custody procedures. Completed and signed Individual Core Collection Forms will be provided by the samplers to the Sample Processing Area personnel when relinquishing the collected cores for sample processing. The Sample Processing Area personnel will sign the Individual Core Collection Form accepting custody of the cores.

A sample is considered under the sampler's custody if one or more of the criteria are met:

- sample is in the sampler's possession;
- sample is in the sampler's view after being in sampler's possession;
- sample was in the sampler's possession and then locked up to prevent tampering; or
- sample is in a designated secure area.

Samples collected for analysis will be continuously tracked in the Sample Processing Area and while in transit to the laboratory by use of the following procedures below. The Sample Processing Area will be secured (locked) with limited access.

- Individual sample bottles will be properly labeled and securely sealed before being placed in the container for shipment to the laboratory.

- Pertinent information will be entered on the chain of custody form in the field (see attached chain of custody form and form key). Assignment of the SDG number, the matrix spike/matrix spike duplicate (MS/MSD) assignments, and the analyses requested for each sample will be made on both the SDG Tracking Log (see attached SDG Tracking Form) and the chain of custody form.

- The chain of custody form must include the following, as required by guidance in SW-846, Test Methods for Evaluating Solid Waste (USEPA, Third Edition, including Promulgated Update I, 1993, Chapter One): 1) project name; 2) signatures of samplers; 3) sample number, date and time of collection, and grab or composite sample designation; 4) signatures of individuals involved in sample transfer; and 5) if applicable, the air bill or other shipping number.

- The completed chain of custody form will be signed, dated, enclosed in a sealable

plastic bag with a copy of the SDG Tracking Log and placed in the container prior to shipment. A copy of both documents will be retained by field personnel and stored in a dedicated binder. Additional copies will be distributed as follows:

- a copy will be faxed to the FC or the FC's designee;
- a copy will be faxed to the data validator; and
- a copy will be faxed to the lab manager/client service representative at each laboratory being used.

- Samples will be considered in the sampler's custody while in his/her possession or within sight, or locked in a secure area prior to shipment. If the person packing the container and verifying the sample list is different than the sampler, both the sampler and the packer will sign the chain of custody form.

- Upon receipt at the laboratory, the designated laboratory sample custodian shall sign the chain of custody form indicating receipt of the incoming field samples. The samples shall be checked against the chain of custody form upon arrival at the laboratory. The receiving personnel will enter all arriving samples into a laboratory logbook. Any discrepancies between the samples and the chain of custody form(s), or any evidence of tampering with the shipping container or the custody seal will be immediately reported to the FC. The sample custodian will immediately check the temperature of the cooler upon arrival at the laboratory and record the measured temperature on the chain of custody form and in a laboratory logbook.

- A copy of the chain of custody form shall be distributed to the following individuals on the day of sample receipt:

  - a copy will be faxed to the FC or the FC's designee;
  - a copy will be faxed to the data validator; and
  - a copy will be faxed to the field office.

  The original shall be retained by the Laboratory's sample custodian.

5.0 DOCUMENTATION

5.1 FIELD NOTES

Documentation of sample handling activities will be conducted in accordance with SOP No. 1 – Field Documentation. The following information should also be included in the logbook (at a minimum):

- sample IDs collected on that day;
- brief synopsis of types of equipment and methods used in collecting the samples; and
- details regarding the field adjustment of preservatives, if necessary.

5.2 CHAIN OF CUSTODY DOCUMENTATION

Samples will be tracked through chain of custody documentation as described in Section 4.5 of this procedure.

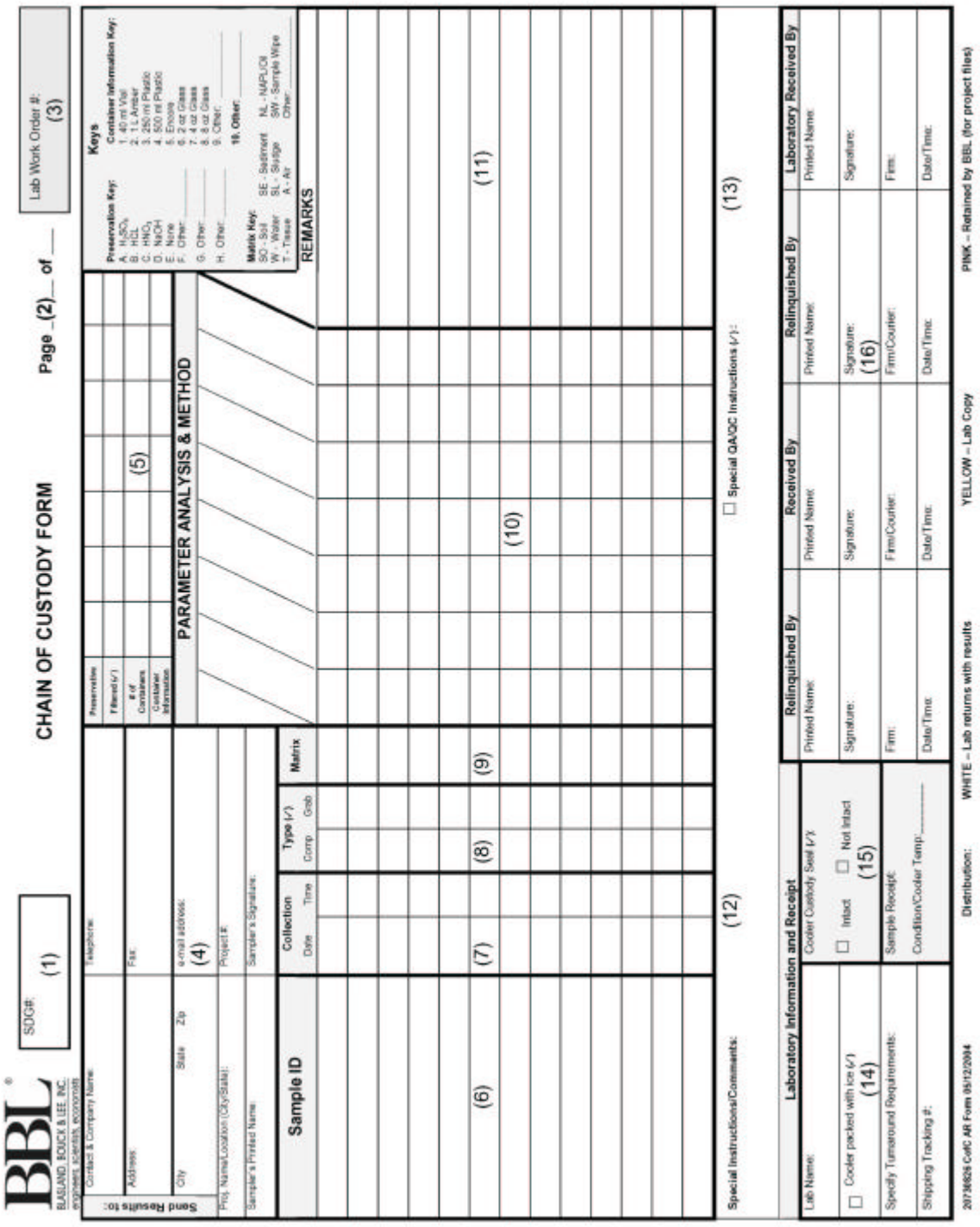
PREPRINTED SAMPLE LABEL

	PROJECT #: (1) PROJECT NAME: Newark Bay Phase I SI Program
SDG #: (2)	
SAMPLE #: (3)	GEOMORPHIC AREA (4)
DATE SAMPLE COLLECTED: (5)	TIME SAMPLE COLLECTED: (6)
LABORATORY: (7)	
SAMPLE MATRIX: (8)	
ANALYSES REQUIRED: (9)	
PRESERVATIVE: (10)	
SAMPLER: (11)	
REMARKS: (12)	

Key:

(1) Company-specific project number, if appropriate
(2) SDG Number
(3) Sample Number (e.g., NB01SED030B-02)
(4) Geomorphic area (e.g., Transitional Slopes)
(5) Date sample was collected from the core (e.g., 1/1/2005)
(6) Time sample was collected from the core (EST)
(7) Laboratory used for analyses
(8) Sample matrix type (e.g., water, sediment)
(9) Analyses required for sample
(10) Preservative(s) used on sample (pre-preserved by the lab)
(11) Sampler name
(12) Remarks pertinent to proposed analyses

CHAIN OF CUSTODY FORM



CHAIN OF CUSTODY FORM KEY

(1) SDG Number (as described in Section 4.2.2 of this SOP) (e.g., NB1003).

(2) Page number and total number of pages for the set of chain of custody form submitted with the samples for analysis.

(3) Analytical laboratory's internal work order number (to be completed by analytical laboratory).

(4) Address where the analytical results are to be sent, project identifiers (location and internal project numbers) and sampler's signature.

(5) Preservation methods and bottles.

(6) Sample ID (e.g., NB01SED03B-03); refer to Section 4.2.1 of this SOP for sample and QA sample IDs.

(7) Date and time (EST) of sample collection.

(8) Check if sample was a composite or grab sample.

(9) Sample matrix (e.g., sediment, water).

(10) Provide analysis and method for which sample is being submitted. Check the appropriate box for which analyses the sample is being submitted.

(11) Provide any pertinent comments regarding the sediment sample submitted for analyses (e.g., not enough sample volume for full analyses).

(12) Provide any special instructions to the analytical laboratory.

(13) Provide any special QA/QC instructions to the analytical laboratory.

(14) Provide details regarding the cooler shipment (analytical laboratory name, whether the cooler was packed with ice, turnaround requirements, and shipping tracking number).

(15) Provide details as to receipt of cooler (to be completed by analytical laboratory on receipt). Indicate if the chain of custody seal was intact and the cooler temperature upon receipt.

(16) Signatures for custody to be completed by sampler and analytical laboratory.

SDG TRACKING LOG

SDG Number _____(1)_____ **SDG Open Date** _____(3)_____
Sample Matrix _____(2)_____ **SDG Close Date** _____(4)_____

Sample #	Sample ID	MS/MSD	Comments
1	(5)	(6)	(7)
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Rinsate Blank	(8)	N/A	(9)

Notes:

1. The SDG must not exceed 20 field samples. Rinsate Blanks do not count towards the sample total. Check which of the 20 samples have been collected to include extra volume for MS/MSD and assign as such.
2. 3x the weights listed should be collected for lab QC (i.e., MS/MSD/internal lab duplicate).
3. Field duplicate is a separate sample, not to be confused with "internal lab duplicate."

SDG TRACKING LOG KEY

(1) SDG number (as described in Section 4.2.2 of this SOP) (e.g., NB1003).

(2) Matrix of samples in this SDG (e.g., sediment).

(3) Date first sample in SDG is collected.

(4) Date last sample in SDG is collected (not to exceed seven days beyond the open date entered in Line 3; described in Section 6.7 of the IWP).

(5) Sample ID (e.g., NB01SED030B-03).

(6) Check if a MS or MSD analysis should be performed on this sample. If a MS or MSD is to be performed, note in the "Comments" column which analysis the MS/MSD should be performed for. If the sample is not to be analyzed for a MS/MSD, then leave blank.

(7) Provide any pertinent comments regarding the sediment samples submitted for analyses (e.g., "MS for Herbicide").

(8) Rinsate blank ID as described in Section 4.2.3 of this SOP (e.g., NB1003RB).

(9) Provide any pertinent comments regarding the rinsate blank submitted for analyses.

STANDARD OPERATING PROCEDURE NO. 3

DECONTAMINATION

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for decontamination of equipment, instruments, and other materials used during implementation of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). Decontamination is the process of neutralizing, washing, and rinsing exposed surfaces of equipment to minimize the potential for contaminant migration and/or cross-contamination. This procedure does not apply to personnel decontamination which is described in RIWP Volume 3 (Tierra, 2005).

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Field Documentation;
- SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis; and
- SOP No. 9 – Management and Disposal of Residuals.

4.0 PROCEDURES

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- bristle brushes;
- wash/rinse tubs;
- low phosphate detergent;
- 10% nitric acid, ultrapure;
- acetone, methanol, and hexane (pesticide grade or better in separate Teflon bottles), as necessary;
- deionized "analyte-free" water;
- stainless steel bowls;
- aluminum foil;
- tap water (from any treated municipal water supply);
- high-pressure/steam cleaner;
- sample container(s) for rinsate blank, if collected; and
- logbook.

4.2 SAMPLING EQUIPMENT DECONTAMINATION

Sampling equipment (including newly purchased equipment) that comes into contact with the media to be sampled will be decontaminated prior to use in the field to eliminate or minimize cross-contamination. The frequency of decontamination is provided in SOP No. 6 – Sediment Collection Using Hand Coring Device, SOP No. 7 – Sediment Collection Using Vibracoring Device, SOP No. 8 – Core Processing, SOP No. 11 - Sediment Collection Using Grab Sampling Device, and SOP No. 12 – Sediment Profile Imaging. Sufficient decontaminated equipment must be available to be dedicated to the sampling points planned for each day. Equipment will be decontaminated in the area designated for decontamination.

The decontamination procedure followed by USEPA Region 2 (USEPA Region 2, Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Quality Assurance Manual, October 1989, Revision 1) will be used prior to each sampling event for equipment that will come into contact with the media to be sampled. The USEPA Region 2 procedures are summarized below:

1. Wash and scrub with low phosphate detergent.
2. Rinse with tap water.
3. Rinse with 10% nitric acid (HNO_3), ultrapure.
4. Rinse with tap water.
5. Spray or rinse with acetone only or a methanol followed by hexane spray or rinse (solvents must be pesticide grade or better).
6. Rinse thoroughly with deionized ("Analyte-Free") water.
7. Air dry.
8. Wrap in aluminum foil, shiny side out, for temporary storage and transport.

For the Phase I Sediment Investigation (SI) Program, sediment samples will be submitted for chemical, radiochemical, and geotechnical analyses as described in Tables 6-1 and 6-2, respectively, of the IWP. Sampling equipment will be decontaminated as described in Section 4.2.1 below. Decontamination of the sampling equipment will be sufficient for collecting samples for the analysis of polychlorinated dibenzo-p-dioxins/polychlorinated dibenzo-p-furans (PCDD/PCDF), plus all other analytes, and will consist of a methanol rinse followed by a hexane rinse as described in Section 4.2.1.

Solvents used during decontamination activities will be collected and handled in accordance with residuals management procedures outlined in SOP No. 9 – Management and Disposal of Residuals.

Not all sampling equipment will require the full decontamination procedures listed in the USEPA Region 2 CERCLA Quality Assurance Manual. Three levels of decontamination (i.e., solvent, soap and water, or ambient [Newark Bay] water decontamination) will be performed based on the usage of the sampling equipment as defined below.

4.2.1 DECONTAMINATION WITH SOLVENTS

The following steps will be used to decontaminate small sampling equipment that will come into contact with sediment designated for chemical analysis (e.g., stainless steel trowels, spoons and bowls, polybutyrate core tubes, stainless steel core cutters and catchers, and plastic caps for the core tubes):

- Personnel will dress in suitable PPE to reduce exposure to chemicals and contaminants (RIWP Volume 3 [Tierra, 2005]).

- Residual sample media at the coring location (i.e., on the coring vessel while on site) will be scraped off and the equipment rinsed with Newark Bay water.
- Residual sample media on equipment at the sample processing site will be scraped off and collected according to residuals management procedures outlined in SOP No. 9 – Management and Disposal of Residuals.

- Equipment will be placed in a wash tub or bucket containing Alconox (or other low-phosphate detergent) along with tap water, and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub or bucket, followed by a nitric acid rinse (for metals analyses), a tapwater rinse, an acetone only rinse, or a methanol rinse followed by a hexane rinse (for organic analyses), and lastly with a deionized water rinse. Rinses shall utilize sufficient amounts of solvent/water to flush rather than just wet the surface. The volume of deionized water used during the rinse must be at least five times the volume of solvent used.

- Following decontamination, equipment will be placed in a clean area and allowed to air dry. Following air drying, the equipment will be wrapped in aluminum foil, shiny side out, until used for sample collection.

- Used decontamination water will be collected and handled in accordance with residuals management procedures outlined in SOP No. 9 – Management and Disposal of Residuals.

4.2.2 DECONTAMINATION WITH SOAP AND WATER

The following steps will be used to decontaminate equipment that is not intended to collect samples for chemical analysis:

- Personnel will dress in suitable PPE to reduce exposure to contaminants (RIWP Volume 3 [Tierra, 2005]).

- Residual sample media at the coring location (i.e., on the coring vessel while on site) will be scraped off and the equipment rinsed with Newark Bay water.

- Residual sample media on equipment at the sample processing site will be scraped off and collected according to residuals management procedures outlined in SOP No. 9 – Management and Disposal of Residuals.

- Equipment will be placed in a wash tub or bucket containing Alconox (or other low-phosphate detergent) along with tap water, and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub or bucket, and then rinsed again.

- Following decontamination, equipment will be placed in a dedicated clean area.
- Rinse water and detergent water will be replaced frequently. Used decontamination water will be collected and handled in accordance with residuals management procedures outlined in SOP No. 9 – Management and Disposal of Residuals.

4.2.3 DECONTAMINATION WITH AMBIENT (NEWARK BAY) WATER

The following steps will be used to decontaminate sampling and support vessels, vessel anchors, lines, ropes, submersible pump and hose (not intended for sample collection), vibracoring head, and buoy marker weights:

- Personnel will dress in suitable PPE to reduce exposure to contaminants (RIWP Volume 3 [Tierra, 2005]).

- Equipment will be rinsed with Newark Bay water onboard the sampling vessel.

- Rinse water will not be contained.

Daily decontamination of the decks of the vessels will consist of a Newark Bay water washing as soon as possible after concluding work. Further wash-down with tap water at the marina is at the discretion of the boat's captain.

4.3 FIELD INSTRUMENTS AND EQUIPMENT

Instrumentation should be cleaned according to the manufacturer's instructions. Care will be taken to prevent damage to equipment. When possible, instruments which are difficult to decontaminate, such as cameras and data logging instruments, may be protectively wrapped to reduce or eliminate the need for decontamination.

4.4 OTHER EQUIPMENT DECONTAMINATION

Other sampling equipment that might be used that has had direct contact with sediments or wastes shall be decontaminated at a designated area prior to leaving the Site. The decontamination procedure will be as follows:

- Equipment will be wrapped or draped in plastic or placed in the plastic-lined cargo area of a truck for transport to the area designated for decontamination.

- Equipment will first be washed with a hot water, high-pressure spray or steam-cleaned.

- Equipment will then be rinsed, by hose or high pressure spray, with tap water.

- Wash and rinse water will be collected and handled in accordance with residuals management procedures outlined in SOP No. 9 – Management and Disposal of Residuals.

4.5 EQUIPMENT LEAVING NEWARK BAY

Equipment leaving the Site upon the completion of onsite investigation activities will be decontaminated according to Sections 4.2, 4.3, or 4.4 above.

5.0 QUALITY ASSURANCE (Rinsate Blanks)

The following decontamination QA/QC procedures will be performed to assess the adequacy of equipment decontamination procedures. Rinsate blanks will be collected by pouring deionized analyte-free water over a representative set of sampling equipment (e.g., sampler, bowl, pan) after it has been decontaminated. The rinsate will be collected in a previously decontaminated stainless steel bowl and transferred to sample bottles for analysis with other samples. Rinsate blanks may require field preservation or field testing as specified in SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. Rinsate blanks will be collected at the frequency specified in the IWP.

6.0 DOCUMENTATION

Field personnel are responsible for documenting decontamination activities related to their onsite activities in accordance with SOP No. 1 – Field Documentation. In addition to this, the following information should also be included in the logbook (at a minimum):

- Information concerning items decontaminated and the procedure utilized; and
- Information related to the collection of rinsate blank samples.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 4

TIDE GAGE INSTALLATION

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for installation of a tide gage as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to install a tide gage. More specific information regarding the tide gage can be found in the IWP.

This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report. SOP No. 1 – Field Documentation will also be utilized with this procedure.

4.0 PROCEDURES

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- navigation charts;
- appropriate equipment and hardware for installing the tide gage;
- tide gage;
- logbook; and
- permanent marker or grease pencil.

4.2 INSTALLATION PROCEDURES

This section presents the general procedures for tide gage installation. Specific installation procedures will vary given the type of gage being installed, the location, and the structure to which the gage is being attached.

The tide gage will be a commercially available unit and will be installed according to the instructions provided by the manufacturer. A stilling well, or equivalent device, will be installed to minimize the effect of non-tidal water level fluctuation (induced by boat traffic or winds), if necessary.

Appropriate access authorization will be obtained prior to installing the tide gage to a bridge pier, bulkhead, or similar anchoring point. The gage will be secured to a bridge pier, bulkhead, or similar anchoring point so that the gage cannot be moved laterally or vertically. Following installation, the gage will be surveyed for vertical location from a third order benchmark or better (within 0.01-foot accuracy). The gage elevation will be established to 0.01 foot in the North American Vertical Datum of 1988 (NAVD88). The gage will also be surveyed for horizontal location (within 1-foot accuracy), established in the New Jersey State Plane Coordinate System, with respect to the North American Datum of 1983 (NAD83).

5.0 QUALITY ASSURANCE

Appropriate QA/QC procedures will be followed during surveying of each tide gage location and elevation, including use of horizontal and vertical control points. The survey work will meet a minimum of third order vertical accuracy for conventional traverse. A level loop and the closing error will be recorded. Benchmarks set will also be recorded. In addition, the following items shall be checked during the installation process:

- security of the mounting system, eliminating the possibility of gage movement;
- clock/time accuracy (referenced to EST); and
- setting of a time-mark on the tide gage (e.g., noting the exact time in the logbook that tide gage is placed in the water).

6.0 DOCUMENTATION

Field notes will be kept during installation activities in accordance with SOP No. 1 – Field Documentation. In addition, the following information should also be included in the logbook (at a minimum):

- Date and time of installation;
- Location of the gage in NJ State Plane Coordinates (feet), and brief description of the vicinity;
- For a pressure gage, record distance (feet) from the pressure transducer to the vertical datum;
- Specifications of gage;
- Installation method;
- Unusual conditions or problems with installation;
- Time that installation was completed; and
- Vertical datum and control points.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 5

POSITIONING

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for positioning sampling/coring vessels for the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). Positioning will be conducted to locate the vessel(s) with sufficient accuracy and precision to meet project objectives during the biologically active zone (BAZ) investigation and sediment sampling activities. Positioning procedures for vessels associated with bathymetric surveying are discussed in SOP No. 10 – Bathymetric Surveying.

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to position coring vessels. Specific information regarding proposed core locations is provided in the IWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized with this procedure, including:

- SOP No. 1 – Field Documentation;
- SOP No. 4 – Tide Gage Installation;
- SOP No. 6 – Sediment Collection Using Hand Coring Device;
- SOP No. 7 – Sediment Collection Using Vibracoring Device;
- SOP No. 10 – Bathymetric Surveying;
- SOP No. 11 – Sediment Collection Using Grab Sampling Device; and
- SOP No. 12 – Sediment Profile Imaging.

4.0 PROCEDURES

Activities (e.g., coring, sediment profile imaging [SPI]) will be conducted within the Phase I SI Study Area from a coring/sampling vessel(s). In accordance with procedures outlined below, these vessels must be properly positioned and their position recorded before each activity can begin.

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- vessel(s) adequate for Newark Bay conditions;
- 25 watt marine VHF radio;
- navigation charts and Phase I SI Program Core Locations figure (Figure 6-1 of the IWP);
- Differential Global Positioning System (DGPS) Receivers (x2) with an accuracy of $\pm$1 foot;
- DGPS External Antennas (x2);
- equipment user manuals;
- table of target sampling location coordinates;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices);
- logbook;
- Core Collection Forms, Individual Core Collection Forms, BAZ Investigation Forms, and Grab Sample Collection Forms; and
- permanent marker or grease pencil.

4.2 POSITIONING VESSEL

This section gives the step-by-step procedures for vessel positioning. Observations made during vessel positioning should be recorded on the BAZ Investigation, Core Collection, Individual Core Collection, and Grab Sample Collection Forms and/or logbook, as appropriate.

A DGPS will be used to establish locations during implementation of activities specified in the IWP. Two DGPS units will be required: one on board the vessel with a receiving antenna to be aligned with the deployment of the sampling apparatus, and the other at a known fixed location (monument or temporary benchmark) to provide corrections to the standard GPS signal.

While this SOP provides general guidance and procedural steps, personnel performing positioning activities also should follow the appropriate sections of equipment user's manuals and have the manuals available for reference at all times.

The following procedures describe the steps to establish position at a location, as well as the steps to adjust the positioning for collection of additional cores, grab samples, or SPI.

4.2.1 ESTABLISHING POSITION AT A LOCATION

Preliminary Activities

1. For each of the planned locations for the day, obtain the appropriate form(s) (i.e., BAZ Investigation Form, Core Collection Form). Complete the Daily Activity Log provided in SOP No. 1 – Field Documentation.

2. For each of the planned locations for the day, obtain the target sampling locations. For Phase I activities, these locations will have been selected prior to commencement of field activities, as described in the IWP, and as shown on Figure 6-1 and listed in Table 6-3. The location of each target sampling location will be established in the New Jersey State Plane Coordinate System with respect to the North American Datum of 1983 (NAD83).

3. Enter coordinates for the locations into the DGPS unit that will be on board the vessel as a waypoint.

Field Activities

1. Establish a DGPS base station over a shore-based marker prior to coring operations. The operation and horizontal/vertical accuracy of the vessel mounted DGPS will be verified at another shore-based marker by recording observed horizontal and vertical (XYZ) data and comparing these data to the published XYZ data for a given point. After initial DGPS system verification, a temporary benchmark may be established at a location convenient to the vessel to facilitate daily DGPS system performance verification.

2. Verify receiving antenna is properly aligned with the sampling device (e.g., vibracorer, SPI camera).

3. Identify and approach actual sampling locations by using data from the DGPS unit in the navigation mode. The navigation mode provides information on heading, distance remaining, and time remaining. This information is based on the selected waypoint

location and the present location of the vessel.

4. Anchor the vessel adjacent to the planned location, if desired.

5. Once the vessel is on location and secured, note the coordinates from the DGPS unit and check the coordinates to verify that the vessel is within the pre-determined range of the target location (i.e., 5 feet for coring, grab sampling, or SPI). If not acceptable, adjust the vessel's location, and recheck the position. Repeat this process until the vessel's position is within acceptable range of the target. Record the final coordinates on the appropriate form.

6. Once the coordinates are acceptable, perform activity at the location. For the Phase I SI Program, collect SPI in accordance with SOP No. 12 – Sediment Profile Imaging and grab samples in accordance with SOP No. 11 – Sediment Collection Using Grab Sampling Device for BAZ activities. Similarly, collect grab samples/cores in accordance with the appropriate SOP, either SOP No. 6 – Sediment Collection Using Hand Coring Device, SOP No. 7 – Sediment Collection Using Vibracoring Device, or SOP No. 11 – Sediment Collection Using Grab Sampling Device for sediment collection activities. Record final location coordinates on the appropriate form once the sampling/coring device has penetrated the sediment to the target depth or refusal and prior to retrieval. Plot locations onto a master chart or use computer-based, real-time software to verify location.

7. At the end of the sampling day, check the data loaded onto the DGPS units to verify the existence of sampling/coring locations where data were collected.

4.2.2 ADJUSTING POSITION DURING PHASE I SI ACTIVITIES

The following steps will be used to adjust position for SPI, grab sampling, or coring activities.

Adjusting SPI Position

1. Move vessel 10 feet from initial location and within a 50-foot radius of the target coordinates.

2. Check the coordinates to verify that the vessel is within 50 feet of the target coordinate and note on the BAZ Investigation Form.

3. Once the coordinates are acceptable, collect SPI in accordance with SOP No. 12 – Sediment Profile Imaging and grab samples in accordance with SOP No. 11 – Sediment Collection Using Grab Sampling Device for BAZ activities. Record the final locations on the BAZ Investigation Form.

4. Repeat Steps 1 through 3 until the appropriate number of SPI/grab samples are collected.

Adjusting Coring/Grab Sampling Position

1. Move vessel 10 feet from initial sampling/coring location and within a 50-foot radius of the target coordinates. For transitional slope coring locations, traverse on a parallel course with the slope to maintain the target water depth of 15 (± 2) feet.

2. Check the coordinates to verify that the vessel is within 50 feet of the target coordinate and note on the Individual Core Collection Form or Grab Sample Collection Form.

3. Once the coordinates are acceptable, collect grab samples/cores in accordance with the appropriate SOP, either SOP No. 6 – Sediment Collection Using Hand Coring Device, SOP No. 7 – Sediment Collection Using Vibracoring Device, or SOP No. 11 – Sediment Collection Using Grab Sampling Device for sediment collection activities. Record the final core location on the Individual Core Collection Form or Grab Sample Collection Form.

4. Repeat Steps 1 through 3 until the appropriate number of grab sample/cores are collected.

4.3 CALIBRATION, MAINTENANCE, AND USE OF FIELD INSTRUMENTS

DGPS units will be calibrated in accordance with appropriate sections of the equipment user's manual, and as described in Section 4.2 of this SOP. Maintenance and use of DGPS units should follow the appropriate sections of the equipment user's manual. Field personnel will have the manual available for reference.

Despite virtually worldwide, 24-hour coverage, technical difficulties with GPS satellites can still occur. In the event of system-wide or other long-term problems with GPS (e.g., satellite failures), vessel positioning will be achieved using land-based methods. If a land-based method is selected, an SOP will be developed for its use.

5.0 QUALITY ASSURANCE

For Phase I SI Program, QA activities for positioning procedures include verification of the SPI, grab sample, or core location by comparing the target coordinates specified in Table 6-3 of the IWP with coordinates entered into the DGPS, and by plotting the coordinates on a master chart.

6.0 DOCUMENTATION

Detailed positioning data will be recorded on the BAZ Investigation, Grab Sample Collection, Core Collection, and Individual Core Collection Forms provided in SOP No. 1 – Field Documentation. In addition, the following information will be recorded in a logbook (at a minimum):

- Notes on breaking position during BAZ activities and sampling/coring;
- Equipment calibration information; and
- Summary of vessel activities.

STANDARD OPERATING PROCEDURE NO. 6

SEDIMENT COLLECTION USING HAND CORING DEVICE

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for collecting cores using a hand coring device as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP).

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to collect cores. Specific information regarding core and sample collection and analysis can be found in the IWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 3 – Decontamination;
- SOP No. 5 – Positioning;
- SOP No. 8 – Core Processing; and
- SOP No. 9 – Management and Disposal of Residuals.

4.0 PROCEDURES

Cores may be collected within the Newark Bay Phase I Sediment Investigation (SI) Study Area using a hand coring device. Following collection, cores will be transported to the Sample Processing Area. Core processing procedures are described in SOP No. 8 – Core Processing.

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- navigation charts and Phase I SI Program Core Locations figure (Figure 6-1 of the IWP);
- sampling vessel adequate for Newark Bay conditions;
- marine VHF radio;
- positioning equipment;
- decontaminated polybutyrate coring tube with end caps;
- decontaminated core driver;
- decontaminated stainless steel core catcher;
- hacksaw;
- decontaminated hacksaw blades;
- decontaminated drill bits;
- drill;
- Daily Activity Log, Core Collection Form, and Individual Core Collection Form;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices [PFDs]);
- logbook;
- permanent marker or grease pencil;
- fathometer with a resolution of 0.1 foot;
- tape measure;
- submersible pump and hose;
- core storage rack to hold cores vertical and cold during temporary storage on-board coring vessel;
- duct tape;
- camera; and
- decontamination equipment/supplies.

4.2 SAMPLING PROCEDURES

This section outlines the step-by-step procedures for collecting cores manually using a hand coring device. Observations made during core collection should be recorded on the Daily Activity Log, Core Collection Form, and Individual Core Collection Form, and in a logbook (SOP No. 1 – Field Documentation).

4.2.1 DECONTAMINATION OF EQUIPMENT

Decontamination of the polybutyrate core tubes and stainless steel core catcher will be performed in accordance with procedures outlined in SOP No. 3 – Decontamination. The decontamination activities will occur on shore and will be conducted with enough time before vessel departure to allow for the decontamination activities to be completed (including drying of the decontaminated equipment). A sufficient amount of decontaminated equipment will be brought on the coring vessel for the planned coring activities for that day.

4.2.2 LOCATING CORING POSITION

1. The coring schedule for the day will be established prior to vessel departure, and sufficient equipment to complete the work will be on board the sampling vessel. The coring crew will be informed prior to departure of the coring locations. The number of cores (nominal 4-inch diameter) to be collected at each location depends on the geomorphic area (Section 6 of the IWP).

2. The coring vessel will move to a coring location in accordance with SOP No. 5 – Positioning.

4.2.3 COLLECTION OF CORES

1. Complete Daily Activity Log and Core Collection Form.

2. Don PPE as required by RIWP Volume 3 (Tierra, 2005).

3. Activate the submersible pump in preparation of cleaning the coring tube and core driver during retrieval.

4. Obtain water depth (to nearest 0.1 foot) from the fathometer and record on the Individual Core Collection Form.

5. Determine minimum length of core needed using the following equation:

   Minimum core length needed (feet) = water depth (feet) + target penetration (feet) + 1 foot + stick-up/core driver (feet)

6. On the coring tube, mark the distance to drive the core (target penetration [feet] + water depth [feet] + 1 foot [i.e., plug]). An additional foot of sediment is collected to obtain a "plug" at the bottom of the core (i.e., to minimize the loss of sediment from the core). If necessary, a core catcher may be used to prevent sediment from escaping.

7. The core will be collected without the use of a core catcher. If the sediment cannot be retained in the core tube without a core catcher, then one will be used.

8. If a core catcher is required, the core catcher will be attached to the bottom of the core tube prior to lowering the core tube into the water.

9. Gently place hand corer on top of the sediment.

10. Lightly drive the coring tube, with straight, vertical entry, into the sediment with a core driver until the targeted core depth is reached (or refusal), as indicated by the markings.

11. Measure and record the penetration on the Individual Core Collection Form. Record final core location coordinates on the Core Collection and Individual Core Collection Forms.

12. To prevent the loss of sediment from the core tube, either use a vacuum pump affixed to an appropriate fitting or use a one-way valve at the top of the core tube.

13. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

14. Before the bottom of the coring tube breaks the water surface, place a cap over the bottom to prevent the loss of material from the core tube. Place the cap on the core tube by reaching down into the water.

15. If using a core catcher, remove the core from the water and bring aboard the sampling vessel deck. Remove core catcher and secure a cap in place with duct tape.

16. Bring core to the vessel's deck and secure the cap in place with duct tape.

17. Clean the core tube and core driver on the vessel by hosing them down with Newark Bay water. Remove one-way valve.

18. Evaluate whether core penetration and recovery are acceptable using the procedures outlined in Sections 4.2.4 and 4.2.5, respectively.

19. Keeping the core tube upright, use a hacksaw with a decontaminated blade or drill with a decontaminated drill bit to make a cut/hole in the core tube approximately 3 to 4 inches above the sediment to allow excess water to seep from the core tube. Continue to make cuts/holes in the core tube, lowering 1 inch each time until reaching the sediment/water interface. When all excess water has been drained from above the sediment/water interface, cut off excess core tube.

20. Cap the cut end of the tube, secure cap with duct tape, and draw an arrow toward this cap. Label "top" to indicate the top of the core. Label the core with the location ID, date, and time, and record this information on the Individual Core Collection Form.

21. Measure the recovered length of the sediment in the core tube (to the nearest 0.1 foot to the extent possible) and record it on the Individual Core Collection Form. The distance between the top of the sediment in the coring tube and the bottom of the coring tube corresponds to the recovered length. Apparent gaps should be noted on the Individual Core Collection Form and the length and location(s) of the gap(s) noted. The total gap length will be subtracted from the total recovery length.

22. Store the core vertically in a core storage rack (capable of keeping cores cold) while on the vessel until it can be transported to the Sample Processing Area. Cores greater than 6 feet will be segmented on the vessel to allow for storage and transportation. Cut these cores at the location of a planned sample segmentation (see Table 6-3 of the IWP) using a hacksaw with a decontaminated blade and recap the exposed ends. Add appropriate markings to indicate the location and segmentation of each section.

4.2.4 PROCEDURES FOR DETERMINING ACCEPTABLE CORE PENETRATION

1. Calculate penetration percentage using the following equation:

$$\text{Penetration}\,(\%) = \frac{\text{actual penetration}\,(\text{feet})}{\text{target penetration}\,(\text{feet})} \times 100$$

Actual penetration is the depth advanced into the sediment not including the depth advanced to form a plug.

2. Record penetration percentage on the Individual Core Collection Form.

3. If penetration ≥75%, then penetration is acceptable. Proceed to Section 4.2.5, Procedures for Determining Acceptable Core Recovery.

4. If penetration is <75%, then (a) retain core and (b) record on Individual Core Collection Form if low penetration is due to refusal. Record additional penetration notes in Notes section of the Individual Core Collection Form. Move to a new coring position, in accordance with SOP No. 5 – Positioning. Upon three unsuccessful attempts to obtain >75% penetration, contact PM to determine if additional cores should be attempted. Proceed to Section 4.2.5, Procedures for Determining Acceptable Core Recovery.

4.2.5 PROCEDURES FOR DETERMINING ACCEPTABLE CORE RECOVERY

1. Calculate recovery percentage using the following equation:

$$\text{Recovery}(\%) = \frac{\text{recovery}(\text{feet}) - \text{gaps (feet)}}{\text{actual penetration}(\text{feet})} \times 100$$

2. Record recovery percentage on the Individual Core Collection Form.

3. If recovery ≥75%, then recovery is acceptable. Continue processing core, then move to a new core position in accordance with SOP No. 5 – Positioning. Proceed to Step 2 of Section 4.2.3 for collection of second core (if necessary based on geomorphic area). Note that only the biologically active zone (BAZ) interval (0 - 0.5 foot) is necessary from the second core (with a target penetration of 1.5 feet). If recovery <75%, proceed with Step 4.

4. If recovery <75%, then (a) retain core; and (b) move to a new coring location in accordance with SOP No. 5 – Positioning. Upon three attempts to obtain >75% recovery, contact Project Manager to determine if additional cores should be attempted.

5. Upon collection of acceptable cores, proceed to Section 4.2.6 of this SOP, Management of Cores.

4.2.6 MANAGEMENT OF CORES

1. Assign the "primary" core designation to the first acceptable core. If >75% recovery was not achieved, assign the "primary" core designation to the core with the highest recovery. Record "primary" core in the Notes section of the Individual Core Collection Form, and mark "primary" on the core liner.

2. If a second core is collected (based on geomorphic area), assign the "BAZ" core designation to the second acceptable core. Note that this core only needs to be approximately 1.5 feet, as only the BAZ interval (0 - 0.5 foot) is necessary. Record "BAZ" core in the Notes section of the Individual Core Collection Form, and mark "BAZ" on the core liner.

3. If more than two cores were collected, return excess sediment into Newark Bay at the core location. Dispose of solid material (e.g., core tube, caps, etc.) in accordance with SOP No. 9 – Management and Disposal of Residuals.

4. Verify that the lengths of the core tubes, water depth, and positioning data have been recorded on the Individual Core Collection Form.

5. Prior to transit to the next coring location or return to the marina, decontaminate the core driver and sampling vessel decking as described in SOP No. 3 – Decontamination.

6. Proceed to next core location specified for that day and repeat above procedures.

7. Completed Core Collection and Individual Core Collection Forms will be provided to the Sample Processing Area personnel when relinquishing cores for processing.

5.0 QUALITY ASSURANCE

Completing the Daily Activity Log, Core Collection Form, and the Individual Core Collection Form provided in SOP No. 1 – Field Documentation, will document that the process is being followed and the pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms will be double-checked by the samplers to verify the information is correct. Completed forms will be reviewed periodically by the FC and/or Project Quality Assurance Officer or their designees to verify that the requirements are being met.

6.0 DOCUMENTATION

Field notes will be kept during coring activities in accordance with SOP No. 1 – Field Documentation. In addition to information contained in the Daily Activity Log, Core Collection Form, and Individual Core Collection Form, times of equipment decontamination will be recorded in a logbook.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 7

SEDIMENT COLLECTION USING VIBRACORING DEVICE

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for collecting cores using a vibracoring device as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP).

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to collect cores. Specific information regarding coring can be found in the IWP.

This SOP may change, depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 3 – Decontamination;
- SOP No. 5 – Positioning;
- SOP No. 8 – Core Processing; and
- SOP No. 9 – Management and Disposal of Residuals.

4.0 PROCEDURES

Cores may be collected within the Newark Bay Phase I Sediment Investigation (SI) Study Area using a vibracoring device. Following collection, cores will be transported to the sample processing area. Core processing procedures are described in SOP No. 8 – Core Processing.

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- navigation charts and Phase I SI Program Core Locations figure (Figure 6-1 of the IWP);
- sampling vessel adequate for Newark Bay conditions;
- marine VHF radio;
- positioning equipment;
- vibracore device;
- deployment equipment (e.g., A-frames, winches, generator);
- decontaminated polybutyrate core tubes;
- decontaminated stainless steel core catcher;
- decontaminated stainless steel core cutter;
- hacksaw;
- decontaminated hacksaw blades;
- decontaminated drill bits;
- drill;
- Daily Activity Log, Core Collection Form, and Individual Core Collection Form;
- core storage racks to hold cores vertical and cold during temporary storage on-board coring vessel;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices [PFDs]);
- logbooks;
- permanent marker or grease pencil;
- fathometer with a resolution of 0.1 foot;
- tape measure;
- submersible pump and hose;
- duct tape;
- camera; and
- decontamination equipment/supplies.

4.2 SAMPLING PROCEDURES

This section gives the step-by-step procedures for collecting cores using a vibracore. Observations made during sediment core collection should be recorded in the Daily Activity Log, Core Collection Form, and Individual Core Collection Form, and a logbook (SOP No. 1 – Field Documentation).

4.2.1 DECONTAMINATION OF EQUIPMENT

Decontamination of the polybutyrate core tubes, stainless steel core cutter, and stainless steel core catcher assemblies will be performed prior to vessel departure in accordance with procedures outlined in SOP No. 3 - Decontamination. The decontamination activities will occur on shore and will be conducted with enough time before vessel departure to allow for the decontamination activities to be completed (including drying of decontaminated equipment). A sufficient amount of decontamination equipment and supplies will be brought on the coring vessel to accommodate the need for miscellaneous, unforeseen decontamination.

4.2.2 LOCATING CORING POSITION

1. The coring schedule for the day will be established prior to vessel departure, and sufficient equipment to complete the work will be on board the sampling vessel. The coring crew will be informed prior to departure of the coring locations and the number of cores required at each location. The number of cores (nominal 4-inch diameter) to be collected at each location depends on the geomorphic area (Section 6 of the IWP).

2. The vibracoring vessel will move to a coring location in accordance with SOP No. 5 – Positioning.

4.2.3 COLLECTION OF CORES

1. Complete Daily Activity Log and Core Collection Form.

2. Don PPE as required by RIWP Volume 3 (Tierra, 2005).

3. Activate the submersible pump in preparation for cleaning the vibracore and coring tube, upon retrieval.

4. Attach steel core casing and core tube into the vibracore head as it lies horizontally on the deck. Secure the core catcher and core cutter to the end of the core casing.

5. Slowly winch the vibracore into its deployment orientation.

6. Obtain water depth (to nearest 0.1 foot) from the fathometer and record on Individual Core Collection Form.

7. Slowly lower the vibracore into the water using the winch or other deployment equipment.

8. Slowly lower the vibracore through the water column to the sediment surface using the water depth reading.

9. Record the "zero" mark on the winch cable.

10. Slowly lower vibracore into sediment under its own weight until it stops. Turn on the motor. Record the start time on the Individual Core Collection Form. Slowly penetrate the sediment to the target penetration as indicated in Table 6-3 of the IWP, or refusal.

11. Lower vibracore approximately 1 foot more to obtain a "plug" at the bottom of the core (i.e., to minimize loss of sediment from core). Record the end time on the Individual Core Collection Form.

12. On completion of the required penetration, or upon vibracore refusal, turn the motor off. Record the vibracore penetration depth on the Individual Core Collection Form.

13. Record the final core location coordinates on the Core Collection and Individual Core Collection Forms.

14. Slowly raise the vibracore, while maintaining the core in a vertical position.

15. Bring vibracore to sampling vessel deck while maintaining the core in a vertical position. Remove core cutter and core catcher, replace with cap, and secure cap with duct tape.

16. Clean the vibracore barrel and coring assembly by hosing down the equipment with Newark Bay water as described in SOP No. 3 – Decontamination.

17. Remove the core tube from the vibracore barrel and place a cap on bottom of the coring tube, keeping the core tube in an upright position.

18. Return the vibracore device to its onboard, deck storage location.

19. Clean the core tube by hosing it down with Newark Bay water. Care should be taken not to direct water into the open end of the core tube.

20. Evaluate whether core penetration and recovery are acceptable using the procedures outlined in Sections 4.2.4 and 4.2.5, respectively.

21. Keeping the core tube upright, use a hacksaw with a decontaminated blade or drill with a decontaminated drill bit to make a cut/hole in the core tube approximately 3 to 4 inches above the sediment to allow excess water to seep from the core tube. Continue to make cuts/holes in the core tube, lowering 1 inch each time until reaching the sediment/water interface. When all excess water has been drained from above the sediment/water interface, cut off excess core tube.

22. Cap the cut end of the tube, secure cap with duct tape, and draw an arrow toward the cap. Draw an arrow on the coring tube with permanent marker and label "top" to indicate the top of the core. Label the core with the location ID, date, and time, and record this information on the Individual Core Collection Form.

23. Measure the recovered length of the sediment in the core tube (to the nearest 0.1 foot to the extent possible) and record it on the Individual Core Collection Form. The distance between the top of the sediment in the coring tube and the bottom of the coring tube corresponds to the recovered length. Apparent gaps should be noted on the Individual Core Collection Form and the length and location(s) of the gap(s) should be noted. The total gap length will be subtracted from the total recovery length.

24. Store the core vertically in a core storage rack (capable of keeping cores cold) while on the vessel until it can be transported to the sample processing area. Cores greater than 6 feet will be segmented on the vessel to allow for storage and transportation. Cut these cores at the location of a planned sample segmentation (see Table 6-3 of the IWP) using a hacksaw with a decontaminated blade and recap the exposed ends. Add appropriate markings to indicate the location and segment of each section.

4.2.4 PROCEDURES FOR DETERMINING ACCEPTABLE CORE PENETRATION

1. Calculate penetration percentage using the following equation:

$$\text{Penetration}(\%) = \frac{\text{actual penetration}(\text{feet})}{\text{target penetration}(\text{feet})} \times 100$$

2. Record penetration percentage on the Individual Core Collection Form.

3. If penetration =75%, then penetration is acceptable. Proceed to Section 4.2.5, Procedures for Determining Acceptable Core Recovery.

4. If penetration <75%, then (a) retain core and (b) record on the Individual Core Collection Form if due to refusal. Record additional penetration notes at the Notes section of the Individual Core Collection Form. Move to a new coring position in accordance with SOP No. 5 – Positioning. Upon three unsuccessful attempts to obtain >75% penetration, contact Project Manager to determine if additional cores should be attempted. Proceed to Section 4.2.5, Procedures for Determining Acceptable Core Recovery.

4.2.5 PROCEDURES FOR DETERMINING ACCEPTABLE CORE RECOVERY

1. Calculate recovery percentage by the following equation:

$$\text{Recovery}(\%) = \frac{\text{recovery}(\text{feet}) - \text{gaps (feet)}}{\text{actual penetration}(\text{feet})} \times 100$$

Actual penetration is the depth advanced into the sediment, not including the depth advanced to form a plug.

2. Record recovery percentage on the Individual Core Collection Form.

3. If recovery =75%, then recovery is acceptable. Continue processing core, then move to a new core location in accordance with SOP No. 5 – Positioning. Proceed to Step 2 of Section 4.2.3 for collection of second core (if necessary based on geomorphic area). Note that only the biologically active zone (BAZ) interval (0 - 0.5 foot) is necessary from the second core with a targeted penetration of 1.5 feet. If the recovery <75%, proceed to Step 4.

4. If recovery <75%, then (a) retain core and (b) move to a new coring position in accordance with SOP No. 5 – Positioning. Upon three unsuccessful attempts to obtain >75% recovery, contact Project Manager to determine if additional cores should be attempted.

5. Upon collection of acceptable core(s), proceed to Section 4.2.6 of this SOP, Management of Cores.

4.2.6 MANAGEMENT OF CORES

1. Assign the "primary" core designation to the first acceptable core. If >75% recovery was not achieved, assign the "primary" core designation to the core with the highest recovery. Record "primary" core in the Notes section of the Individual Core Collection Form, and mark "primary" on the core liner.

2. If a second core is collected (based on geomorphic area), assign the "BAZ" core designation to the second acceptable core. Note that this core only needs to be approximately 1.5 feet, as only the BAZ interval (0 – 0.5 foot) is necessary. Record "BAZ" core in the Notes section of the Individual Core Collection Form, and mark "BAZ" on the core liner.

3. If more than two cores were collected, return excess sediment into Newark Bay at the core location. Dispose of solid material (e.g., core tube, caps) in accordance with SOP No. 9 – Management and Disposal of Residuals.

4. Verify that the lengths of the core tubes, water depth, and positioning data have been recorded on the Individual Core Collection Form.

5. Prior to transit to the next coring location or return to the marina, decontaminate the coring equipment and sampling vessel decking as described in SOP No. 3 – Decontamination.

6. Proceed to next core location specified for that day and repeat above procedures.

7. Completed Core Collection and Individual Core Collection Forms will be provided to the Sample Processing Area personnel when relinquishing cores for processing.

5.0 QUALITY ASSURANCE

Completing the Daily Activity Log, Core Collection Form, and the Individual Core Collection Form provided in SOP No.1 – Field Documentation, will document that the process is being followed and that pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms will be double-checked by the samplers to verify the information is correct. Completed forms will be reviewed periodically by the FC and/or Project Quality Assurance Officer or their designees to verify that the requirements are being met.

6.0 DOCUMENTATION

Field notes will be kept during coring activities in accordance with SOP No. 1 – Field Documentation. In addition to information contained in the Daily Activity Log, Core Collection Form, and Individual Core Collection Form, the times of equipment decontamination will be recorded in a logbook.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 8

CORE PROCESSING

2.0 TABLE OF CONTENTS

ATTACHMENTS

SEGMENTATION TABLES (1 through 13)

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for processing of the cores collected as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). Core processing includes observational and photologging of cores, collection of samples from the cores for bulk density, grain size, chemical analyses, and radiochemical analyses. Core processing will be conducted to meet the sample collection and analysis objectives defined in the IWP.

This SOP may change depending upon field conditions at Newark Bay or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis;
- SOP No. 3 – Decontamination;
- SOP No. 6 – Sediment Collection Using Hand Coring Device;
- SOP No. 7 – Sediment Collection Using Vibracoring Device; and
- SOP No. 9 – Management and Disposal of Residuals.

4.0 PROCEDURES

Cores will be processed in accordance with the procedures outlined below.

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- sample processing table;
- logbook and associated Core Lithology/Description Forms and Sample Processing Forms;
- ruler or measuring tape;
- hacksaw and spare decontaminated blades;
- table of target sample location coordinates;
- electric sheet metal shears or similar;
- sampling equipment: stainless steel spatulas and bowls;
- sample bottles for chemical and radiochemical analyses;
- refrigerator, at 4^{o}C;
- digital camera with flash;
- EnCore samplers and T-handle;
- stainless steel dividing blades/knives;
- Unified Soil Classification System (USCS) Charts;
- photoionization detector (PID) (with calibration kit);
- core storage rack to hold cores vertical and keep cold prior to either processing or placement in a refrigerator;
- appropriate waste disposal equipment; and
- scales to weigh sediment cores and samples.

4.2 PROCEDURE

The core processing procedure presented in this SOP is a multi-step process. The exact procedures and steps will depend on whether the core contains high water content sediments (i.e., material that would slump if placed horizontally). In advance of processing, each core will be visually inspected to determine if it contains high water content sediments, and consequently, whether it can be processed horizontally or vertically. Cores will then be logged and photographed, bulk density analysis will be performed, and samples will be collected and submitted for grain size, and chemical and radiochemical analyses.

4.2.1 DECONTAMINATION OF EQUIPMENT

Decontamination of equipment prior to contact with sediment will be performed in a designated decontamination area. The decontamination will be performed in accordance with procedures outlined in SOP No. 3 – Decontamination. Equipment decontamination will be conducted sufficiently ahead of the processing activities to allow for the implementation of proper procedures (including drying of decontaminated equipment).

4.2.2 PRELIMINARY ACTIVITIES PRIOR TO PROCESSING

These steps will be undertaken prior to core processing.

1. Acquire the necessary sampling equipment (e.g., decontaminated stainless steel processing equipment), containers, and label the sample containers with the appropriate sample labels.

2. Upon delivery of the core to the processing laboratory, a hard copy of the forms initiated for each core during coring operations, the Daily Activity Log, the Core Collection Form, and the Individual Core Collection Form, will be provided to the Sample Processing Area personnel (SOP No. 1 – Field Documentation). The Individual Core Collection Form will be signed by the coring personnel and the Sample Processing Area personnel. The Individual Core Collection Form will serve as the chain of custody document from the field to the Sample Processing Area.

3. Cores will be maintained in a vertical position in a core storage rack (capable of keeping cores cold) while in transit to the Sample Processing Area. At the Sample Processing Area, cores will be stored vertically and kept cold (in either the refrigerator or core storage rack) prior to processing. The Sample Processing Area will be within a secure (i.e., locked) location, allowing for limited access.

4. Transcribe the pertinent field information from the Individual Core Collection Form to the Core Description Form.

5. Dry the surface of the core tube with clean paper towels and measure the length of the core tube.

6. Determine the bulk density of the sediments according to the procedures outlined in Section 4.2.3.

7. Keeping the core vertical, remove top cap from the core to be processed. Visually inspect the sediment in the BAZ (0 – 0.5 feet below the sediment surface) and near-surface sediments to determine if they are high water content sediments. High water content sediments would slump if placed horizontally.

8. If the BAZ and near-surface sediments are comprised of high water content sediments then the core will be processed as described in Section 4.2.4 below.

9. If the BAZ and near-surface sediments are not comprised of high water content sediments, then the core will be processed as described in Section 4.2.5 of this SOP.

4.2.3 DETERMINING THE BULK DENSITY OF SEDIMENT

Prior to initiating coring activities, average weights for core tubes and caps will be determined for use in calculating the bulk density. First, an average weight per unit length (i.e., linear foot) of core tube will be established by weighing a minimum of 20 linear feet of core tube. Second, an average weight of caps will be established by weighing a minimum of 20 caps. These values will be incorporated into the bulk density equation provided below.

1. Weigh the sediment core and record the weight of the sediment and core tube ($W_{sediment\&tube}$) in the Sample Processing Form.

2. Measure the length of sediment subtracting out any gaps. Record the sediment length ($L_{sediment}$) in the Sample Processing Form.

3. Calculate the sediment bulk density using the following formula, and record the result in the Sample Processing Form.

$$r_{bulk} = \frac{W_{sediment}}{A_{tube} * L_{sediment}} = \frac{W_{sed\&tube} - W_{tube} - W_{caps}}{A_{tube} * L_{sediment} * 30.48 \frac{cm^3}{ft^3}}$$

where:

ρ_{bulk}	=	wet bulk density in g/cm^3
$W_{sediment}$	=	weight of sediment in the tube in grams
$W_{sed\&tube}$	=	weight of sediment and tube in grams
W_{tube}	=	weight of empty tube in grams = length of tube in feet * weight of tube per unit length in feet/grams
A_{tube}	=	inner cross sectional area of the coring tube in $feet^2$ ($0.067\ ft^2$ for a 3.5-inch nominal inner diameter coring tube)
$L_{sediment}$	=	length of sediment in the tube in feet (i.e., length of sediment – gaps)

4. Begin processing the core according to Section 4.2.4 (high water content) or Section 4.2.5 (non-high water content).

4.2.4 CORE PROCESSING FOR HIGH WATER CONTENT SEDIMENTS

As previously described, if the core contains high water content sediments, then the procedures outlined in this section will be used. The procedures involve keeping the core in a vertical position and then carefully removing the high-water content sediments into a stainless steel bowl for processing or directly into the EnCore samplers for VOC analysis. The cores cannot be placed horizontally until sediment of sufficiently low water content is reached, such that the sediment will not slump when placed horizontally on the core processing table.

1. With the core in the vertical position, mark the outside of the core tube in 1-inch increments, beginning at the sediment-water interface, and proceeding down far enough until it is expected that low water content sediments will be encountered. Also, mark the core tube with the sample interval boundaries for chemical and radiochemical analysis, beginning at the same location.

2. While the core is in a vertical position, remove the sediment from the segment using a stainless steel utensil and place the sediment in a stainless steel bowl. Place half of the sediment volume from the core segment in one bowl (for chemical analysis) and half into another bowl (for radiochemical analysis).

3. Screen the sediment in the bowls with a PID and record in the Core Lithology/Description Form.

4. For VOC analysis, the sediment will be placed into an EnCore sampler until the sampler is full. Sediment for VOC analysis will be collected with three EnCore samplers. Collect a sample for moisture content (for use in VOC analysis) from the same location as the VOC samples were collected. Collect the moisture content sample using a stainless steel utensil and place in the appropriate sample container.

5. Visually describe the sediments in the stainless steel bowls. Using the Unified Soil Classification System (USCS) record the description of the soil type in the appropriate section of the Core Lithology/Description Form. Provide a description of approximate grain size (silt, clay, fine sand, medium sand, coarse sand, and gravel), the presence of observable biota or organic matter, odor, and color. Note any unusual observations in the appropriate column. Identify changes in lithology (such as soil type or grain-size) within the core. If changes in lithography are observed, then the approximate length of various layers will be noted. Changes in lithology will be separated with a line on the Core Lithology/Description Form.

6. Photograph the sediment in the stainless steel bowls. If foreign objects are present or unusual characteristics are noted, photograph the object or unusual characteristic. Make sure an adequate amount of light is available to photograph the sediment.

7. Record a description of each photograph in a logbook. Descriptions will include photo number, date, time (EST), core number, depth interval shown in picture, and photographer's name. Unusual observations will also be recorded.

8. For the 0 – 0.5 foot BAZ sample, collect additional sediment from the BAZ core (if collected based on geomorphic area) and place in the same stainless steel bowl (containing sediments for homogenization for chemical analyses) as the primary core BAZ sample interval. Do not use the sediment from the BAZ core for radiochemical analyses.

9. Thoroughly mix the sample in the center of a stainless steel bowl for chemical analysis. Homogenize the sediment until color and texture differences are no longer detected. Only homogenize the sediment for chemical analysis; do not homogenize the sediment for radiochemical analysis.

10. Fill pre-labeled sample jars for remaining chemical and radiochemical analyses, in accordance with SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. Sediment samples for chemical analyses will be obtained from the bowl with homogenized sediment. Sediment samples for radiochemical analysis will be obtained from a separate bowl (as described in Step 2). Confirm that the sample identification has been recorded in the Sample Processing Form.

11. If determined necessary by the Sample Processing Area personnel, the individual sample bottles may be weighed to ensure appropriate sample volume for lab analysis.

12. Remaining sediment and core tube lengths will be stored or disposed of in accordance with SOP No. 9 – Management and Disposal of Residuals.

13. The sample containers will be labeled and processed according to SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

14. For the next sample interval, visually inspect the core to determine whether the next interval contains high water content sediments. If the core does not contain high water content sediments, then the remaining core segments can be processed as described in Section 4.2.5 below. If the core does contain high water sediments, continue to process the core following these procedures.

4.2.5 CORE PROCESSING FOR NON-HIGH WATER CONTENT SEDIMENTS

As described above, if the core does not contain high water content sediments, then the procedures outlined in this section will be used. The procedures involve:

- Laying the core horizontal and splitting it lengthwise (one half for chemical analysis and the other for radiochemical analysis);
- Screening the core with a PID and collecting samples for VOC analysis;
- Logging and photologging the core; and
- Collecting sediment samples for analysis.

Detailed procedures are as follows:

1. Transfer the core to the sample processing table.

2. Using the electric sheet metal shears (or other cutting device), make two longitudinal cuts along the core tube; one on each side. Open the tube lengthwise and carefully split the core in half. Decontaminated stainless steel dividing plates may be used to ensure equal sectioning.

3. Screen the core with a PID and record in the Core Lithology/Description Form one reading for every 0.5 foot of core screened.

4. Calculate sample intervals for chemical samples using the Sample Processing Form in accordance with Section 4.2.6 of this SOP, Core Sample Interval Selection. Mark the specified sampling interval ranges on the outside of the core tube.

5. Prior to collecting samples, transcribe the pertinent field information from the Individual Core Collection Form to the Sample Processing Form.

6. Remove the smear zone of the specified range to be sampled. To remove the smear zone, scrape sediment exposed to the core tube and discard in accordance with SOP No. 9 – Management and Disposal of Residuals.

7. Immediately after smear zone removal, remove EnCore sampler from bag. Hold EnCore sampler coring body and push the plunger rod down until the small O-ring rests against the tabs. This will ensure that the plunger moves freely. Sediment for VOC analysis will be collected with three EnCore samplers.

8. Depress the locking lever on the EnCore T-handle. Place coring body, plunger end first, into the open end of the T-handle aligning the slots on the coring body with the locking pins on the T-handle. Twist the coring body clockwise to lock the pins in the slots. Check to ensure the EnCore Sampler is locked in place.

9. Turn T-handle with T up and coring body down. Using the T-handle, push the sampler into the sediment in one half of the core tube until the coring body is completely full (when full, the small O-ring will be centered in the T-handle viewing hole). Remove the sampler from the sediment and wipe excess sediment from the coring body exterior.

10. Cap the sampler while it is still on the T-handle. Push cap over the flat area of the ridge and twist to lock the cap in place. The cap must be seated to seal the sampler. If the cap appears crooked, the locking arms are not fully seated over the coring body ridge. Remove the cap and reseat.

11. Remove the capped sampler by depressing the locking lever on the T-handle while twisting and pulling the sampler from the T-handle.

12. Lock the plunger by rotating the extended plunger rod fully counterclockwise until the wings rest firmly against the tabs.

13. Attach completed circular label (from the EnCore sampler bag) over the cap.

14. Return the full EnCore sampler to its bag, seal the bag, and place in transportation cooler on ice. Package and label the sample container following the procedures in SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

15. Continue collecting the VOC samples as described in Steps 7 through 14 for each segment of the core (see Table 6-3 of the IWP). Collect a sediment grab sample for moisture content from the same location as the VOC samples (for use in the VOC analysis). Collect the moisture content sample using a stainless steel utensil and place in the appropriate sample container.

16. With the core split open, visually describe the core. Using the USCS, record the description of the soil type in the appropriate section of the Core Lithology/Description Form. Provide a description of approximate grain size (silt, clay, fine sand, medium sand, coarse sand, and gravel), the presence of observable biota or organic matter, odor, and color. Note any unusual observations in the appropriate column. Identify changes in lithology (such as soil type or grain-size) within the core. If changes in lithography are observed, then the approximate length of various layers will be noted. Changes in lithology will be separated with a line on the Core Lithology/Description Form.

17. Photograph the exposed section of the core. Include a ruler or measuring tape for scale and mark the top and bottom and ends of the core. If foreign objects or gaps are present, or unusual observations are made, photograph the object or subject of the observations. Make sure an adequate amount of light is available to photograph core.

18. Record a description of each photograph in a logbook. Descriptions will include photo number, date, time (EST), core number, depth interval shown in picture, and photographer's name. Unusual observations will also be recorded.

19. For each sample interval, collect sediment using a decontaminated stainless steel utensil from one half of the split core and place in the appropriate decontaminated stainless steel bowl.

20. For the 0 – 0.5 foot BAZ sample, collect additional sediment from the BAZ core (if collected based on geomorphic area) and place in the same stainless steel bowl as the primary core BAZ sample interval for homogenization.

21. Thoroughly mix the sample in the center of a stainless steel bowl. Homogenize the sediment until color and texture differences are no longer detected. Only homogenize sediment for chemical analysis; do not homogenize the sediment for radiochemical analysis.

22. Fill pre-labeled sample jars for remaining chemical analyses, in accordance with SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. Confirm that the sample identification has been recorded in the Sample Processing Form.

23. If determined necessary by the Sample Processing Area personnel, the individual sample bottles may be weighed to ensure appropriate sample volume for lab analysis.

24. For each radiochemical sample interval, collect sediment from the remaining half of the split core and place in the pre-labeled radiochemical sample containers, in accordance with SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

25. Remaining sediment and core tube lengths will be stored or disposed of in accordance with SOP No. 9 – Management and Disposal of Residuals.

26. The sample containers will be labeled and processed according to SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

4.2.6 CORE SAMPLE INTERVAL SELECTION

Tables included at the end of this SOP provide the target sample intervals for chemical analyses and radiochemical analyses based on the geomorphic area and penetration. Section 6.3.1 of the IWP presents the rationale for the selection of the target sample intervals. A list of sample containers to be used for each analysis is specified in SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

4.2.7 COLLECTION OF QUALITY ASSURANCE SAMPLES

4.2.7.1 FIELD QUALITY CONTROL (QC) SAMPLES

QC samples will be collected during core sample processing. QC samples will be labeled, maintained, and transported in accordance with SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis. QC samples will include rinsate blanks and field duplicate samples. The QC samples will be collected at the frequency specified in Table 5-12 of the IWP.

4.2.7.2 RINSATE BLANKS

For the core processing, one rinsate blank will be collected for every 20 field samples (not to exceed one per day). The procedures for the collection of rinsate blanks are described in SOP No. 3 – Decontamination. The parameters that are being analyzed in the rinsate samples are listed in Table 5-11 of the IWP. The rinsate sample is labeled, maintained, and transported in accordance with SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis

4.2.7.3 TRIP BLANKS

Trip blanks (volatiles only) are required when solid samples are analyzed for volatile organics. The trip blank is water obtained from the analytical laboratory and carried with the field sample bottles during the sampling event. When the sampling event has ended, the trip blanks are labeled and shipped to the laboratory along with representative field samples for volatile analyses only. Trip blanks will be processed at a frequency of one for each cooler shipped from field to laboratory which contains field samples for volatiles analyses.

4.2.7.4 FIELD DUPLICATE SAMPLES

Field duplicate samples will be collected following the same procedures as the collection of samples for chemical and radiochemical analysis. One field duplicate sample will be collected for every 20 field samples (per matrix and per method). The duplicate samples will be labeled, maintained, and transported in accordance with SOP No. 2 – Containers, Preservation, Handling, and Tracking of Samples for Analysis.

4.2.7.5 LABORATORY QUALITY CONTROL SAMPLES

Matrix spike/matrix spike duplicates (MS/MSD) are required as laboratory QC tests for organic analyses, while matrix spike/duplicates (MS/DUP) are required as laboratory QC tests for metals and cyanide analyses. Within each Sample Delivery Group, one MS/MSD (for each organic analysis type) and MS/DUP (for each inorganic analysis type) must be collected for each analytical group submitted. It is not necessary that the MS/MSD or MS/DUP be derived from the same sample. Therefore, field personnel will designate a sediment sample from each SDG to be used for these analyses for each analytical method. Minimum sample analysis mass requirements, as well as additional Laboratory QC sample mass requirements, are provided in Table 6-5 of the IWP.

5.0 QUALITY ASSURANCE

Completing the Core Lithology/Description Form and Sample Processing Form provided in SOP No. 1 – Field Documentation, will document that the process is being followed and pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms and logbook will be double-checked by the samplers to verify the information is correct. Completed forms will be reviewed periodically by the FC and/or Project Quality Assurance Officer or their designees to verify that the requirements are being met.

6.0 DOCUMENTATION

Field notes will be kept during core processing activities in accordance with SOP No. 1 – Field Documentation. The core weights and sample weights (if collected) will be recorded in the logbook. In addition, the following core photologging information should also be included in the logbook (at a minimum):

- Photo number;
- Time of photo;
- Core number;
- Depth interval shown in the picture;
- Photographer's name; and
- Unusual observations.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

SEGMENTATION TABLES
TABLES 1 through 13

TABLE 1
SEGMENTATION FOR CHEMICAL ANALYSIS FOR SOUTHERN NAVIGATION CHANNELS AND PORT CHANNELS

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)
0.5	0 to 0.5	NA	NA
0.6	0 to 0.5	NA	NA
0.7	0 to 0.5	NA	NA
0.8	0 to 0.5	NA	NA
0.9	0 to 0.5	NA	NA
1.0	0 to 0.5	0.5 to bottom	NA
1.1	0 to 0.5	0.5 to bottom	NA
1.2	0 to 0.5	0.5 to bottom	NA
1.3	0 to 0.5	0.5 to bottom	NA
1.4	0 to 0.5	0.5 to bottom	NA
1.5	0 to 0.5	0.5 to bottom	NA
1.6	0 to 0.5	0.5 to bottom	NA
1.7	0 to 0.5	0.5 to bottom	NA
1.8	0 to 0.5	0.5 to bottom	NA
1.9	0 to 0.5	0.5 to bottom	NA
2.0	0 to 0.5	0.5 to 1.25	1.25 to bottom
2.1	0 to 0.5	0.5 to 1.3	1.3 to bottom
2.2	0 to 0.5	0.5 to 1.35	1.35 to bottom
2.3	0 to 0.5	0.5 to 1.5	1.5 to bottom
2.4	0 to 0.5	0.5 to 1.5	1.5 to bottom
2.5	0 to 0.5	0.5 to 1.5	1.5 to bottom
2.6	0 to 0.5	0.5 to 1.5	1.5 to bottom
2.7	0 to 0.5	0.5 to 1.5	1.5 to bottom
2.8	0 to 0.5	0.5 to 1.5	1.5 to bottom
2.9	0 to 0.5	0.5 to 1.5	1.5 to bottom
3.0	0 to 0.5	0.5 to 1.5	1.5 to bottom

Notes:

NA = Not applicable
Shading denotes grain size sample.

TABLE 2
SEGMENTATION FOR CHEMICAL ANALYSIS FOR NORTHERN NAVIGATION CHANNELS

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)	Segment 5 (ft)	Segment 6 (ft)
2	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
2.25	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
2.5	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.75	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
3	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
3.25	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
3.5	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
3.75	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
4	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
4.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
4.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
4.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
5.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
5.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
5.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to bottom	NA	NA
6	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 4.8	4.8 to bottom	NA
6.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 4.9	4.9 to bottom	NA
6.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5	5 to bottom	NA
6.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.1	5.1 to bottom	NA
7	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.3	5.3 to bottom	NA
7.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.4	5.4 to bottom	NA
7.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.5	5.5 to bottom	NA
7.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.6	5.6 to bottom	NA
8	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.8	5.8 to bottom	NA
8.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.1	5.1 to 6.7	6.7 to bottom
8.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.25	5.2 to 6.8	6.8 to bottom
8.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.3	5.3 to 7	7 to bottom
9	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.3	5.3 to 7.2	7.2 to bottom
9.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.4	5.4 to 7.3	7.3 to bottom
9.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.5	5.5 to 7.5	7.5 to bottom
9.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.6	5.6 to 7.7	7.7 to bottom
10	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.75	5.7 to 7.8	7.8 to bottom
10.25	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.8	5.8 to 8	8 to bottom
10.5	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.8	5.8 to 8.2	8.2 to bottom
10.75	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 5.9	5.9 to 8.3	8.3 to bottom
11	0 to 0.5	0.5 to 1.5	1.5 to 3.5	3.5 to 6	6 to 8.5	8.5 to bottom

Notes:
NA = Not applicable
Shading denotes grain size sample.

TABLE 3
SEGMENTATION FOR CHEMICAL ANALYSIS FOR TRANSITIONAL SLOPES

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)	Segment 5 (ft)	Segment 6 (ft)
0.5	0 to 0.5	NA	NA	NA	NA	NA
0.6	0 to 0.5	NA	NA	NA	NA	NA
0.7	0 to 0.5	NA	NA	NA	NA	NA
0.8	0 to 0.5	NA	NA	NA	NA	NA
0.9	0 to 0.5	NA	NA	NA	NA	NA
1	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.1	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.2	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.3	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.4	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.5	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.6	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.7	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.8	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.9	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
2	0 to 0.5	0.5 to 1.25	1.25 to bottom	NA	NA	NA
2.1	0 to 0.5	0.5 to 1.3	1.3 to bottom	NA	NA	NA
2.2	0 to 0.5	0.5 to 1.35	1.35 to bottom	NA	NA	NA
2.3	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.4	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.5	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.6	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.7	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.8	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.9	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
3	0 to 0.5	0.5 to 1.5	1.5 to 2.25	2.25 to bottom	NA	NA
3.1	0 to 0.5	0.5 to 1.5	1.5 to 2.3	2.3 to bottom	NA	NA
3.2	0 to 0.5	0.5 to 1.5	1.5 to 2.35	2.35 to bottom	NA	NA
3.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.8	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.25	3.25 to bottom	NA
4.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.3	3.3 to bottom	NA

TABLE 3 (cont'd)
SEGMENTATION FOR CHEMICAL ANALYSIS FOR TRANSITIONAL SLOPES

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)	Segment 5 (ft)	Segment 6 (ft)
4.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.35	3.35 to bottom	NA
4.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.8	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.25	4.25 to bottom
5.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.3	4.3 to bottom
5.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.35	4.35 to bottom
5.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.5	4.5 to bottom
5.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.5	4.5 to bottom
5.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.5	4.5 to bottom

Notes:

NA – Not applicable
Shading denotes grain size sample.

TABLE 4
SEGMENTATION FOR CHEMICAL ANALYSIS FOR SUB-TIDAL FLATS (3.5 FT CORES)

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)
0.5	0 to 0.5	NA	NA	NA
0.6	0 to 0.5	NA	NA	NA
0.7	0 to 0.5	NA	NA	NA
0.8	0 to 0.5	NA	NA	NA
0.9	0 to 0.5	NA	NA	NA
1	0 to 0.5	0.5 to bottom	NA	NA
1.1	0 to 0.5	0.5 to bottom	NA	NA
1.2	0 to 0.5	0.5 to bottom	NA	NA
1.3	0 to 0.5	0.5 to bottom	NA	NA
1.4	0 to 0.5	0.5 to bottom	NA	NA
1.5	0 to 0.5	0.5 to bottom	NA	NA
1.6	0 to 0.5	0.5 to bottom	NA	NA
1.7	0 to 0.5	0.5 to bottom	NA	NA
1.8	0 to 0.5	0.5 to bottom	NA	NA
1.9	0 to 0.5	0.5 to bottom	NA	NA
2	0 to 0.5	0.5 to 1.25	1.25 to bottom	NA
2.1	0 to 0.5	0.5 to 1.3	1.3 to bottom	NA
2.2	0 to 0.5	0.5 to 1.35	1.35 to bottom	NA
2.3	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.4	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.5	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.6	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.7	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.8	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.9	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
3	0 to 0.5	0.5 to 1.5	1.5 to 2.25	2.25 to bottom
3.1	0 to 0.5	0.5 to 1.5	1.5 to 2.3	2.3 to bottom
3.2	0 to 0.5	0.5 to 1.5	1.5 to 2.35	2.35 to bottom
3.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom

Notes:

NA – Not applicable.
Shading denotes grain size sample.

TABLE 5
SEGMENTATION FOR CHEMICAL ANALYSIS FOR SUB-TIDAL FLATS (6.5 FT CORES)

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)	Segment 5 (ft)	Segment 6 (ft)
4.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.8	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.5	4.5 to bottom
5.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.6	4.6 to bottom
5.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.7	4.7 to bottom
5.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.8	4.8 to bottom
5.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.9	4.9 to bottom
5.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
5.8	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
5.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom

Notes:

NA – Not applicable.
Shading denotes grain size sample.

TABLE 6
SEGMENTATION FOR CHEMICAL ANALYSIS FOR INTER-TIDAL AREA

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)
0.5	0 to 0.5	NA	NA	NA
0.6	0 to 0.5	NA	NA	NA
0.7	0 to 0.5	NA	NA	NA
0.8	0 to 0.5	NA	NA	NA
0.9	0 to 0.5	NA	NA	NA
1	0 to 0.5	0.5 to bottom	NA	NA
1.1	0 to 0.5	0.5 to bottom	NA	NA
1.2	0 to 0.5	0.5 to bottom	NA	NA
1.3	0 to 0.5	0.5 to bottom	NA	NA
1.4	0 to 0.5	0.5 to bottom	NA	NA
1.5	0 to 0.5	0.5 to bottom	NA	NA
1.6	0 to 0.5	0.5 to bottom	NA	NA
1.7	0 to 0.5	0.5 to bottom	NA	NA
1.8	0 to 0.5	0.5 to bottom	NA	NA
1.9	0 to 0.5	0.5 to bottom	NA	NA
2	0 to 0.5	0.5 to 1. 25	1.25 to bottom	NA
2.1	0 to 0.5	0.5 to 1.3	1.3 to bottom	NA
2.2	0 to 0.5	0.5 to 1. 35	1.35 to bottom	NA
2.3	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.4	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.5	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.6	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.7	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.8	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
2.9	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA
3	0 to 0.5	0.5 to 1.5	1.5 to 2.25	2.25 to bottom
3.1	0 to 0.5	0.5 to 1.5	1.5 to 2.3	2.3 to bottom
3.2	0 to 0.5	0.5 to 1.5	1.5 to 2.35	2. 35 to bottom
3.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
3.8	0 to 0.5	0.5 to 1.5	1.5 to 2. 5	2. 5 to bottom
3.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom
4.0	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom

Notes:
NA – Not applicable.
Shading denotes grain size sample.

TABLE 7
SEGMENTATION FOR CHEMICAL ANALYSIS FOR INDUSTRIAL WATERFRONT AREA

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)	Segment 5 (ft)	Segment 6 (ft)
0.5	0 to 0.5	NA	NA	NA	NA	NA
0.6	0 to 0.5	NA	NA	NA	NA	NA
0.7	0 to 0.5	NA	NA	NA	NA	NA
0.8	0 to 0.5	NA	NA	NA	NA	NA
0.9	0 to 0.5	NA	NA	NA	NA	NA
1	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.1	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.2	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.3	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.4	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.5	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.6	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.7	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.8	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
1.9	0 to 0.5	0.5 to bottom	NA	NA	NA	NA
2	0 to 0.5	0.5 to 1. 25	1.25 to bottom	NA	NA	NA
2.1	0 to 0.5	0.5 to 1.3	1.3 to bottom	NA	NA	NA
2.2	0 to 0.5	0.5 to 1. 35	1.35 to bottom	NA	NA	NA
2.3	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.4	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.5	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.6	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.7	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.8	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
2.9	0 to 0.5	0.5 to 1.5	1.5 to bottom	NA	NA	NA
3	0 to 0.5	0.5 to 1.5	1.5 to 2.25	2.25 to bottom	NA	NA
3.1	0 to 0.5	0.5 to 1.5	1.5 to 2.3	2.3 to bottom	NA	NA
3.2	0 to 0.5	0.5 to 1.5	1.5 to 2.35	2.35 to bottom	NA	NA
3.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
3.8	0 to 0.5	0.5 to 1.5	1.5 to 2. 5	2. 5 to bottom	NA	NA
3.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to bottom	NA	NA
4.0	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.25	3.25 to bottom	NA

TABLE 7 (cont'd)
SEGMENTATION FOR CHEMICAL ANALYSIS FOR INDUSTRIAL WATERFRONT

Penetration (ft)	Segment 1 (ft)	Segment 2 (ft)	Segment 3 (ft)	Segment 4 (ft)	Segment 5 (ft)	Segment 6 (ft)
4.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.3	3.3 to bottom	NA
4.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.35	3.35 to bottom	NA
4.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.8	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
4.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to bottom	NA
5.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.5	4.5 to bottom
5.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.6	4.6 to bottom
5.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.7	4.7 to bottom
5.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.8	4.8 to bottom
5.6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 4.9	4.9 to bottom
5.7	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
5.8	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
5.9	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.1	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.2	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.3	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.4	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom
6.5	0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 to 5.0	5.0 to bottom

Notes:

NA = Not applicable.
Core 012 will include a seventh segment from 6.5 to 8.0 ft.
Shading denotes grain size sample.

TABLE 8
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR NORTHERN NAVIGATIONAL CHANNELS

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.50	6	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.58	7	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.67	8	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
0.75	9	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
0.83	10	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
0.92	11	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.00	12	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.08	13	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.17	14	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.25	15	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.33	16	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.42	17	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.50	18	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.58	19	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.67	20	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.75	21	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.83	22	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
1.92	23	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.00	24	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.08	25	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.17	26	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.25	27	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.33	28	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.42	29	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.50	30	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.58	31	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.67	32	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.75	33	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.83	34	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
2.92	35	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.00	36	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.08	37	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.17	38	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.25	39	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.33	40	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
3.42	41	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42

TABLE 8 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR NORTHERN NAVIGATIONAL CHANNELS

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
3.50	42	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
3.58	43	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
3.67	44	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
3.75	45	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
3.83	46	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
3.92	47	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42
4.00	48	0 to 2	2 to 4	4 to 6	7 to 9	15 to 17	23 to 25	31 to 33	39 to 41	46 to 48
4.08	49	0 to 2	2 to 4	4 to 6	7 to 9	15 to 17	24 to 26	32 to 34	40 to 42	47 to 49
4.17	50	0 to 2	2 to 4	4 to 6	7 to 9	16 to 18	24 to 26	32 to 34	41 to 43	48 to 50
4.25	51	0 to 2	2 to 4	4 to 6	8 to 10	16 to 18	25 to 27	33 to 35	42 to 44	49 to 51
4.33	52	0 to 2	2 to 4	4 to 6	8 to 10	16 to 18	25 to 27	34 to 36	42 to 44	50 to 52
4.42	53	0 to 2	2 to 4	4 to 6	8 to 10	17 to 19	26 to 28	34 to 36	43 to 45	51 to 53
4.50	54	0 to 2	2 to 4	4 to 6	8 to 10	17 to 19	26 to 28	35 to 37	44 to 46	52 to 54
4.58	55	0 to 2	2 to 4	4 to 6	8 to 10	17 to 19	27 to 29	36 to 38	45 to 47	53 to 55
4.67	56	0 to 2	2 to 4	4 to 6	8 to 10	18 to 20	27 to 29	36 to 38	46 to 48	54 to 56
4.75	57	0 to 2	2 to 4	4 to 6	9 to 11	18 to 20	28 to 30	37 to 39	47 to 49	55 to 57
4.83	58	0 to 2	2 to 4	4 to 6	9 to 11	18 to 20	28 to 30	38 to 40	47 to 49	56 to 58
4.92	59	0 to 2	2 to 4	4 to 6	9 to 11	19 to 21	29 to 31	38 to 40	48 to 50	57 to 59
5.00	60	0 to 2	2 to 4	4 to 6	9 to 11	19 to 21	29 to 31	39 to 41	49 to 51	58 to 60
5.08	61	0 to 2	2 to 4	4 to 6	9 to 11	19 to 21	30 to 32	40 to 42	50 to 52	59 to 61
5.17	62	0 to 2	2 to 4	4 to 6	9 to 11	20 to 22	30 to 32	40 to 42	51 to 53	60 to 62
5.25	63	0 to 2	2 to 4	4 to 6	10 to 12	20 to 22	31 to 33	41 to 43	52 to 54	61 to 63
5.33	64	0 to 2	2 to 4	4 to 6	10 to 12	20 to 22	31 to 33	42 to 44	52 to 54	62 to 64
5.42	65	0 to 2	2 to 4	4 to 6	10 to 12	21 to 23	32 to 34	42 to 44	53 to 55	63 to 65
5.50	66	0 to 2	2 to 4	4 to 6	10 to 12	21 to 23	32 to 34	43 to 45	54 to 56	64 to 66
5.58	67	0 to 2	2 to 4	4 to 6	10 to 12	21 to 23	33 to 35	44 to 46	55 to 57	65 to 67
5.67	68	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	33 to 35	44 to 46	56 to 58	66 to 68
5.75	69	0 to 2	2 to 4	4 to 6	11 to 13	22 to 24	34 to 36	45 to 47	57 to 59	67 to 69
5.83	70	0 to 2	2 to 4	4 to 6	11 to 13	22 to 24	34 to 36	46 to 48	57 to 59	68 to 70
5.92	71	0 to 2	2 to 4	4 to 6	11 to 13	23 to 25	35 to 37	46 to 48	58 to 60	69 to 71
6.00	72	0 to 2	2 to 4	4 to 6	11 to 13	23 to 25	35 to 37	47 to 49	59 to 61	70 to 72
6.08	73	0 to 2	2 to 4	4 to 6	11 to 13	23 to 25	36 to 38	48 to 50	60 to 62	71 to 73
6.17	74	0 to 2	2 to 4	4 to 6	11 to 13	24 to 26	36 to 38	48 to 50	61 to 63	72 to 74
6.25	75	0 to 2	2 to 4	4 to 6	12 to 14	24 to 26	37 to 39	49 to 51	62 to 64	73 to 75
6.33	76	0 to 2	2 to 4	4 to 6	12 to 14	24 to 26	37 to 39	50 to 52	62 to 64	74 to 76
6.42	77	0 to 2	2 to 4	4 to 6	12 to 14	25 to 27	38 to 40	50 to 52	63 to 65	75 to 77

TABLE 8 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR NORTHERN NAVIGATIONAL CHANNELS

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
6.50	78	0 to 2	2 to 4	4 to 6	12 to 14	25 to 27	38 to 40	51 to 53	64 to 66	76 to 78
6.58	79	0 to 2	2 to 4	4 to 6	12 to 14	25 to 27	39 to 41	52 to 54	65 to 67	77 to 79
6.67	80	0 to 2	2 to 4	4 to 6	12 to 14	26 to 28	39 to 41	52 to 54	66 to 68	78 to 80
6.75	81	0 to 2	2 to 4	4 to 6	13 to 15	26 to 28	40 to 42	53 to 55	67 to 69	79 to 81
6.83	82	0 to 2	2 to 4	4 to 6	13 to 15	26 to 28	40 to 42	54 to 56	67 to 69	80 to 82
6.92	83	0 to 2	2 to 4	4 to 6	13 to 15	27 to 29	41 to 43	54 to 56	68 to 70	81 to 83
7.00	84	0 to 2	2 to 4	4 to 6	13 to 15	27 to 29	41 to 43	55 to 57	69 to 71	82 to 84
7.08	85	0 to 2	2 to 4	4 to 6	13 to 15	27 to 29	42 to 44	56 to 58	70 to 72	83 to 85
7.17	86	0 to 2	2 to 4	4 to 6	13 to 15	28 to 30	42 to 44	56 to 58	71 to 73	84 to 86
7.25	87	0 to 2	2 to 4	4 to 6	14 to 16	28 to 30	43 to 45	57 to 59	72 to 74	85 to 87
7.33	88	0 to 2	2 to 4	4 to 6	14 to 16	28 to 30	43 to 45	58 to 60	72 to 74	86 to 88
7.42	89	0 to 2	2 to 4	4 to 6	14 to 16	29 to 31	44 to 46	58 to 60	73 to 75	87 to 89
7.50	90	0 to 2	2 to 4	4 to 6	14 to 16	29 to 31	44 to 46	59 to 61	74 to 76	88 to 90
7.58	91	0 to 2	2 to 4	4 to 6	14 to 16	29 to 31	45 to 47	60 to 62	75 to 77	89 to 91
7.67	92	0 to 2	2 to 4	4 to 6	14 to 16	30 to 32	45 to 47	60 to 62	76 to 78	90 to 92
7.75	93	0 to 2	2 to 4	4 to 6	15 to 17	30 to 32	46 to 48	61 to 63	77 to 79	91 to 93
7.83	94	0 to 2	2 to 4	4 to 6	15 to 17	30 to 32	46 to 48	62 to 64	77 to 79	92 to 94
7.92	95	0 to 2	2 to 4	4 to 6	15 to 17	31 to 33	47 to 49	62 to 64	78 to 80	93 to 95
8.00	96	0 to 2	2 to 4	4 to 6	15 to 17	31 to 33	47 to 49	63 to 65	79 to 81	94 to 96
8.08	97	0 to 2	2 to 4	4 to 6	15 to 17	31 to 33	48 to 50	64 to 66	80 to 82	95 to 97
8.17	98	0 to 2	2 to 4	4 to 6	15 to 17	32 to 34	48 to 50	64 to 66	81 to 83	96 to 98
8.25	99	0 to 2	2 to 4	4 to 6	16 to 18	32 to 34	49 to 51	65 to 67	82 to 84	97 to 99
8.33	100	0 to 2	2 to 4	4 to 6	16 to 18	32 to 34	49 to 51	66 to 68	82 to 84	98 to 100
8.42	101	0 to 2	2 to 4	4 to 6	16 to 18	33 to 35	50 to 52	66 to 68	83 to 85	99 to 101
8.50	102	0 to 2	2 to 4	4 to 6	16 to 18	33 to 35	50 to 52	67 to 69	84 to 86	100 to 102
8.58	103	0 to 2	2 to 4	4 to 6	16 to 18	33 to 35	51 to 53	68 to 70	85 to 87	101 to 103
8.67	104	0 to 2	2 to 4	4 to 6	16 to 18	34 to 36	51 to 53	68 to 70	86 to 88	102 to 104
8.75	105	0 to 2	2 to 4	4 to 6	17 to 19	34 to 36	52 to 54	69 to 71	87 to 89	103 to 105
8.83	106	0 to 2	2 to 4	4 to 6	17 to 19	34 to 36	52 to 54	70 to 72	87 to 89	104 to 106
8.92	107	0 to 2	2 to 4	4 to 6	17 to 19	35 to 37	53 to 55	70 to 72	88 to 90	105 to 107
9.00	108	0 to 2	2 to 4	4 to 6	17 to 19	35 to 37	53 to 55	71 to 73	89 to 91	106 to 108
9.08	109	0 to 2	2 to 4	4 to 6	17 to 19	35 to 37	54 to 56	72 to 74	90 to 92	107 to 109
9.17	110	0 to 2	2 to 4	4 to 6	17 to 19	36 to 38	54 to 56	72 to 74	91 to 93	108 to 110
9.25	111	0 to 2	2 to 4	4 to 6	18 to 20	36 to 38	55 to 57	73 to 75	92 to 94	109 to 111
9.33	112	0 to 2	2 to 4	4 to 6	18 to 20	36 to 38	55 to 57	74 to 76	92 to 94	110 to 112
9.42	113	0 to 2	2 to 4	4 to 6	18 to 20	37 to 39	56 to 58	74 to 76	93 to 95	111 to 113

TABLE 8 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR NORTHERN NAVIGATIONAL CHANNEL

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
9.50	114	0 to 2	2 to 4	4 to 6	18 to 20	37 to 39	56 to 58	75 to 77	94 to 96	112 to 114
9.58	115	0 to 2	2 to 4	4 to 6	18 to 20	37 to 39	57 to 59	76 to 78	95 to 97	113 to 115
9.67	116	0 to 2	2 to 4	4 to 6	18 to 20	38 to 40	57 to 59	76 to 78	96 to 98	114 to 116
9.75	117	0 to 2	2 to 4	4 to 6	19 to 21	38 to 40	58 to 60	77 to 79	97 to 99	115 to 117
9.83	118	0 to 2	2 to 4	4 to 6	19 to 21	38 to 40	58 to 60	78 to 80	97 to 99	116 to 118
9.92	119	0 to 2	2 to 4	4 to 6	19 to 21	39 to 41	59 to 61	78 to 80	98 to 100	117 to 119
10.00	120	0 to 2	2 to 4	4 to 6	19 to 21	39 to 41	59 to 61	79 to 81	99 to 101	118 to 120
10.08	121	0 to 2	2 to 4	4 to 6	19 to 21	39 to 41	60 to 62	80 to 82	100 to 102	119 to 121
10.17	122	0 to 2	2 to 4	4 to 6	19 to 21	40 to 42	60 to 62	80 to 82	101 to 103	120 to 122
10.25	123	0 to 2	2 to 4	4 to 6	20 to 22	40 to 42	61 to 63	81 to 83	102 to 104	121 to 123
10.33	124	0 to 2	2 to 4	4 to 6	20 to 22	40 to 42	61 to 63	82 to 84	102 to 104	122 to 124
10.42	125	0 to 2	2 to 4	4 to 6	20 to 22	41 to 43	62 to 64	82 to 84	103 to 105	123 to 125
10.50	126	0 to 2	2 to 4	4 to 6	20 to 22	41 to 43	62 to 64	83 to 85	104 to 106	124 to 126
10.58	127	0 to 2	2 to 4	4 to 6	20 to 22	41 to 43	63 to 65	84 to 86	105 to 107	125 to 127
10.67	128	0 to 2	2 to 4	4 to 6	20 to 22	42 to 44	63 to 65	84 to 86	106 to 108	126 to 128
10.75	129	0 to 2	2 to 4	4 to 6	21 to 23	42 to 44	64 to 66	85 to 87	107 to 109	127 to 129
10.83	130	0 to 2	2 to 4	4 to 6	21 to 23	42 to 44	64 to 66	86 to 88	107 to 109	128 to 130
10.92	131	0 to 2	2 to 4	4 to 6	21 to 23	43 to 45	65 to 67	86 to 88	108 to 110	129 to 131
11.00	132	0 to 2	2 to 4	4 to 6	21 to 23	43 to 45	65 to 67	87 to 89	109 to 111	130 to 132

Note:

NA – Not applicable.

TABLE 9
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR TRANSITIONAL SLOPES

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.50	6	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.58	7	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.67	8	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.75	9	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.83	10	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.92	11	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
1.00	12	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.08	13	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.17	14	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.25	15	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.33	16	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.42	17	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.50	18	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.58	19	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.67	20	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
1.75	21	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
1.83	22	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
1.92	23	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.00	24	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.08	25	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.17	26	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.25	27	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.33	28	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.42	29	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	NA	NA	NA	NA
2.50	30	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
2.58	31	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
2.67	32	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
2.75	33	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
2.83	34	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
2.92	35	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.00	36	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.08	37	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.17	38	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.25	39	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.33	40	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.42	41	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	NA	NA	NA
3.50	42	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA

TABLE 9 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR TRANSITIONAL SLOPES

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
3.58	43	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
3.67	44	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
3.75	45	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
3.83	46	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
3.92	47	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.00	48	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.08	49	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.17	50	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.25	51	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.33	52	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.42	53	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	NA	NA
4.50	54	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
4.58	55	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
4.67	56	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
4.75	57	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
4.83	58	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
4.92	59	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.00	60	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.08	61	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.17	62	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.25	63	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.33	64	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.42	65	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	NA
5.50	66	0 to 2	2 to 4	4 to 6	10 to 12	18 to 20	28 to 30	40 to 42	52 to 54	64 to 66

Note:

NA = Not applicable

TABLE 10
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR SUB-TIDAL FLATS (3.5 FT CORES)

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.50	6	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.58	7	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.67	8	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.75	9	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.83	10	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
0.92	11	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.00	12	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.08	13	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.17	14	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.25	15	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.33	16	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.42	17	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.50	18	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.58	19	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.67	20	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.75	21	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.83	22	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
1.92	23	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.00	24	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.08	25	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.17	26	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.25	27	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.33	28	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.42	29	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.50	30	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.58	31	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.67	32	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.75	33	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.83	34	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
2.92	35	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.00	36	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.08	37	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.17	38	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.25	39	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.33	40	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.42	41	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.50	42	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42

Note:
NA = Not applicable

TABLE 11
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR SUB-TIDAL FLATS (6.5 FT CORES)

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.50	6	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.58	7	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.67	8	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.75	9	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.83	10	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.92	11	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
1.00	12	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.08	13	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.17	14	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.25	15	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.33	16	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.42	17	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.50	18	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.58	19	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.67	20	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.75	21	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.83	22	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.92	23	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
2.00	24	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.08	25	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.17	26	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.25	27	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.33	28	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.42	29	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.50	30	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.58	31	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.67	32	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.75	33	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.83	34	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.92	35	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
3.00	36	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.08	37	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.17	38	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.25	39	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.33	40	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.42	41	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.50	42	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA

TABLE 11 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR SUB-TIDAL FLATS (6.5 FT CORES)

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
3.58	43	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.67	44	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.75	45	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.83	46	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.92	47	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
4.00	48	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
4.08	49	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
4.17	50	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.25	51	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.33	52	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.42	53	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.50	54	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.58	55	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.67	56	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.75	57	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.83	58	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.92	59	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.00	60	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.08	61	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.17	62	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.25	63	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.33	64	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.42	65	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.50	66	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.58	67	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.67	68	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.75	69	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.83	70	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.92	71	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.00	72	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.08	73	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.17	74	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.25	75	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.33	76	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.42	77	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.50	78	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	76 to 78

Note:
NA = Not applicable.

TABLE 12
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR INTER-TIDAL AREA

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.50	6	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.58	7	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.67	8	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.75	9	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.83	10	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
0.92	11	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.00	12	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.08	13	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.17	14	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.25	15	0 to 2	2 to 4	4 to 6	8 to 10	NA	NA	NA	NA	NA
1.33	16	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.42	17	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.50	18	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.58	19	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.67	20	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.75	21	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	NA	NA	NA	NA
1.83	22	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
1.92	23	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.00	24	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.08	25	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.17	26	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.25	27	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
2.33	28	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.42	29	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.50	30	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.58	31	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.67	32	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.75	33	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
2.83	34	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
2.92	35	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.00	36	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.08	37	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.17	38	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.25	39	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.33	40	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.42	41	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	NA
3.50	42	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	32 to 34	40 to 42

TABLE 12 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR INTER-TIDAL AREA

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
3.58	27	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	NA	NA	NA
3.67	28	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
3.75	29	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
3.83	30	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
3.92	31	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA
4.00	32	0 to 2	2 to 4	4 to 6	8 to 10	14 to 16	20 to 22	26 to 28	NA	NA

Note:

NA = Not applicable.

TABLE 13
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR INDUSTRIAL WATERFRONT

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
0.50	6	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.58	7	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.67	8	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.75	9	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.83	10	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
0.92	11	0 to 2	2 to 4	4 to 6	NA	NA	NA	NA	NA	NA
1.00	12	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.08	13	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.17	14	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.25	15	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.33	16	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.42	17	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.50	18	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.58	19	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.67	20	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.75	21	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.83	22	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
1.92	23	0 to 2	2 to 4	4 to 6	10 to 12	NA	NA	NA	NA	NA
2.00	24	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.08	25	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.17	26	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.25	27	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.33	28	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.42	29	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.50	30	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.58	31	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.67	32	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.75	33	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.83	34	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
2.92	35	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	NA	NA	NA	NA
3.00	36	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.08	37	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.17	38	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.25	39	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.33	40	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.42	41	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.50	42	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA

TABLE 13 (cont'd)
SEGMENTATION FOR RADIOCHEMICAL ANALYSIS FOR INDUSTRIAL WATERFRONT

Penetration		Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6	Segment 7	Segment 8	Segment 9
(ft)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(in)
3.58	43	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.67	44	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.75	45	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.83	46	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
3.92	47	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
4.00	48	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
4.08	49	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	NA	NA	NA
4.17	50	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.25	51	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.33	52	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.42	53	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.50	54	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.58	55	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.67	56	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.75	57	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.83	58	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
4.92	59	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.00	60	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.08	61	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.17	62	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.25	63	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	NA	NA
5.33	64	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.42	65	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.50	66	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.58	67	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.67	68	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.75	69	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.83	70	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
5.92	71	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.00	72	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.08	73	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.17	74	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.25	75	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.33	76	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.42	77	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	NA
6.50	78	0 to 2	2 to 4	4 to 6	10 to 12	22 to 24	34 to 36	48 to 50	62 to 64	76 to 78

Notes:

NA = Not applicable.
Core 012 will include a tenth segment from 94 to 96 inches.

STANDARD OPERATING PROCEDURE NO. 9

MANAGEMENT AND DISPOSAL OF RESIDUALS

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for disposal of sediment, water, personal protective equipment (PPE), and other potentially contaminated materials generated during Newark Bay Study Area Remedial Investigation Work Plan (RIWP) operations.

This SOP provides procedures for handling potentially contaminated sediment, water, PPE, and other materials during coring and sampling activities through their ultimate disposal. Specific information regarding handling and disposal of residuals is provided in the IWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modifications to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 3 – Decontamination;
- SOP No. 6 – Sediment Collection Using Hand Coring Device;
- SOP No. 7 – Sediment Collection Using Vibracoring Device;
- SOP No. 8 – Core Processing; and
- SOP No. 10 – Sediment Collection Using Grab Sampling Device.

4.0 PROCEDURES

Potentially contaminated sediment, water, PPE, and other materials will be classified into three categories: (1) solid materials consisting of sediments, sediment samples returned from the laboratory, used polybutyrate core tubes, used PPE, and other materials used in the handling, processing, and storage of sediment (addressed in Section 4.2); (2) liquid wastes such as waste water, decontamination water, and aqueous samples returned from the laboratory (addressed in Section 4.3); and (3) spent and residual chemicals (liquids) from decontamination. Sediment from cores that is not processed for chemical or radiochemical analysis may be either archived or disposed of, and will be segregated and handled separately according to their classification. To the extent practical, liquids generated during coring and core processing operations should be separated from the solid material. Each type of material should be handled in the manner described in this SOP.

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- PPE or other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- 55-gallon open-top drums (Department of Transportation [DOT] approved) with lid;
- 30-gallon (minimum) garbage bags;
- permanent marking pens and/or paint pens;
- duct tape;
- storage racks;
- small (cooler-size) storage containers;
- self-contained core storage facility;
- walk-in cooler or refrigerated trailer;
- chemical storage cabinet (meeting Occupational Safety and Health Administration [OSHA] and National Fire Protection Association [NFPA] Code 30 specifications/Factory Manual [FM] approved);
- logbook; and
- indelible ink pens.

4.2 SOLID MATERIALS

4.2.1 SOLID RESIDUALS FOR DISPOSAL

The remaining solid residuals generated during field activities will be sent for appropriate offsite disposal. These consist of two types of materials: non-sediment solid materials generated during the collection and processing of cores, including items such as used polybutyrate core tubes, aluminum foil from clean core tubes, PPE (e.g., gloves, Tyvek® suits, boot covers), and sediment not used for analyses (e.g., waste sediment such as that collected from the core "smear zone" and residual sediment). Non-sediment and sediment wastes will be segregated and temporarily stored in separate containers pending disposal. Loose sediment will be removed from non-sediment waste items prior to disposal and stored with other sediment wastes.

If recovered sediment is determined to be unusable after a core has been cut open, the sediment will be removed from the core tube and stored in an appropriate container for disposal as waste sediment. The used core tube will be stored and disposed of with the non-sediment solid wastes. Sediment residuals will be placed in 55-gallon drums, labeled, and stored temporarily until disposal in a manner approved by USEPA.

Non-sediment solid materials will be placed in 55-gallon drums or bulk bags and stored temporarily until they can be disposed of in a manner approved by USEPA. All drums and bags containing solids residuals will be labeled and handled as described in Section 4.4 of this SOP.

4.3 LIQUID WASTES

4.3.1 WASTE WATER

Waste water will be generated during sediment core processing and decontamination activities. Water mixed with detergent or chemicals will be drummed for disposal in a manner approved by USEPA. Water from gross decontamination (e.g., to wash sediment from core tubes) will be allowed to stand so that the sediment settles, and the water will be decanted and drummed. Solids remaining after the water is decanted will be handled according to Section 4.2.1 of this SOP.

Aqueous samples returned from the analytical laboratories will be temporarily stored at the sediment processing area until disposal in a manner approved by USEPA.

4.3.2 CHEMICAL LIQUID WASTES

Spent solvents, acids, and other residual chemicals generated during the decontamination

process (SOP No. 3 - Decontamination) will be collected and stored in appropriate containers. These containers will be stored temporarily at the sediment processing area until recycling or disposal in a manner approved by USEPA.

4.4 HANDLING AND TRACKING OF SOLID MATERIALS AND CONTAINERS

As they are generated during field activities, waste sediment and other solid waste materials will be placed in DOT-approved 55-gallon drums or 30-gallon bags. Solid waste materials which are initially placed in bags may be bulked into 55-gallon drums for storage. The following procedures will be followed for storing sediment and other solid waste in these drums:

- A drum number will be assigned to each drum by the FC or designee. The drum number will be clearly marked on multiple places on the drum;
- A log will be kept for each drum, listing the materials placed in that drum. All solid materials will be segregated based on the type of material (e.g., sediment, coring tubes, PPE, waste plastic, paper, or foil) and, to the extent practicable, by where they were generated (e.g., location within Newark Bay, etc.);
- Drums will be closed or covered at the end of the day's work;
- Collection drums may be reused at the processing facility after emptying; and
- Drums containing solid materials will be stored in a secured temporary facility until proper offsite disposal can be coordinated upon completion of the sampling event.

4.5 HANDLING AND TRACKING OF WASTE WATER AND CHEMICAL LIQUID WASTES AND CONTAINERS

As they are generated during field activities, waste water and chemical liquid wastes will be placed in separate DOT-approved 55-gallon drums. The following procedures will be followed for storing waste water and chemical liquid wastes in these drums:

- A separate drum will be used for each non-commingled chemical. Another, separate drum will be used for chemicals and/or water that have been mixed;

- A drum number will be assigned to each drum by the FC or designee. The drum number will be clearly marked on multiple places on the drum;

- A log will be kept for each drum, listing the materials placed in that drum;

- All drums will be closed or covered at the end of the day's work;

- Collection drums may be reused at the Sample Processing Area after emptying; and

- Drums containing waste water and chemical liquid wastes will be stored in a secured temporary facility until proper offsite disposal can be coordinated upon the completion of the sampling event.

4.6 SAMPLES RETURNED FROM OFFSITE LABORATORIES

Upon completion of the required chemical and/or radiochemical analyses, remaining sample material and emptied sample containers from the laboratory will be returned to the Sample Processing Area. Returned sample material will be transported under chain of custody procedures, and remain in custody until disposal. Upon receipt, the chain of custody form will be signed and the samples will be logged-in by a project staff member. The approximate volume of sample material and the condition of the containers in which the samples are returned will be checked and recorded in a logbook.

Samples will be separated into sediment, and aqueous sample groups; empty sample containers will be grouped accordingly by sample matrix. Sediment and aqueous samples will be placed in a DOT-approved 55-gallon drum until they are disposed of in a manner approved by USEPA.

5.0 QUALITY ASSURANCE

Disposal procedures will be documented in a logbook to ensure that disposal activities are conducted in accordance with the procedures outlined in the SOPs. Waste manifests will be obtained for solid and aqueous waste disposal to verify that proper transportation and disposal of these materials has occurred.

6.0 DOCUMENTATION

The FC or designee is responsible for documenting the handling and/or disposal of containers filled with solids or liquids generated during the RIWP activities in accordance with SOP No. 1 – Field Documentation. In addition, the following information should be included in the logbook (at a minimum):

- Name of person performing residual management or disposal activities;
- Date and time of activity;
- Information coordinating container numbers for drums or bags containing solid materials with sample numbers, core boring numbers, or origin; and
- Information coordinating origin of waste liquid (water or chemical[s]) with specific waste drum or tank.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 10

BATHYMETRIC SURVEYING

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for conducting a bathymetric survey as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). This SOP provides descriptions of equipment, field procedures, and documentation necessary to conduct the survey. The objectives and locations of the bathymetric survey are discussed in the IWP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC), and United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 3 – Decontamination; and
- SOP No. 4 – Tide Gage Installation.

4.0 PROCEDURES

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- survey vessel adequate for Newark Bay conditions;
- fathometer with a resolution of 0.1 foot;
- Differential Global Positioning System (DGPS) including a base station and a rover receiver and external antenna;
- calibration plate;
- navigation, plotting, and computer equipment;
- logbook and location map; and
- surveying equipment.

4.2 PROCEDURE

Bathymetric soundings will be collected at approximate 0.25-mile intervals along sounding lines throughout the Phase I Sediment Investigation (SI) Study Area. More closely-spaced, shorter tracklines may also be positioned around shoreline structures, bridge crossings, and sharp grade breaks in the navigation channel banks, as necessary. Survey lines will be pre-plotted prior to commencement of the survey.

One tide gage will be installed within Newark Bay prior to surveying. The gage will be installed according to SOP No. 4 – Tide Gage Installation.

Bathymetry measurements in the shallow, sub-tidal flats will be collected during high-water periods, if boat draft limitations are anticipated. High-water periods will be classified as the period ranging from 2 hours prior to the predicted high tide until 2 hours after the predicted high tide. Conducting the survey during high-water periods will allow measurements to be taken over the shallow, Sub-tidal Flats of Newark Bay, as well as the deeper sections. Bathymetry measurements in the deeper Northern and Southern Navigation Channels and Transitional Slopes may also be performed during low tide. The tide level will be recorded as described in Section 4.3 (below) during the time period the measurements are made.

A DGPS base station will be established over a shore-based marker (USACE monument or temporary benchmark) prior to survey operations. DGPS corrections transmitted to the survey vessel from the base station will allow for the collection of real-time, precision water level data at the survey vessel during bathymetric data collection. The operation and horizontal/vertical accuracy of the vessel mounted DGPS will be verified at another USACE monument or temporary benchmark by recording observed horizontal and vertical (XYZ) data and comparing these data to the known position for that point.

Calibration checks of the fathometer will occur a minimum of twice each day – once before work commences and once after completing the day's activity.

Each survey line recording will be labeled with the survey line number, direction of travel, date, time, and the name of the fathometer operator.

Upon completion of field activities, the profiles will be adjusted using tide data so that depth data are reported relative to the North American Vertical Datum of 1988 (NAVD88).

4.3 BATHYMETRIC SURVEY - GENERAL SPECIFICATIONS

The accuracy of the bathymetry survey will meet or exceed the USACE Class 1 Hydrographic Survey Standard (USACE Hydrographic Surveying Engineer Manual EM 1110-2-1003 dated January 2002). The following are general specifications for the bathymetric survey:

1. Survey Vessel - Adequate for Newark Bay conditions and capable of supporting and operating the bathymetric positioning and sampling equipment.

2. Vessel Positioning - Horizontal positioning system capable of at least $\pm$1 foot accuracy.

3. Vessel Navigation - Navigation system made up of computer-based software providing: display of vessel position relative to intended survey lines (with right/left helmsman indicator); navigation channel limits; aids to navigation; shoreline; and other features. Computer and software (such as Hypack®) will be capable of displaying the cross-section data as acquired (i.e., real-time basis) for the purpose of QA/QC and to log both vessel position and digital depth data.

4. Soundings - Fathometer should be capable of dual-frequency sounding (e.g., 28 and 200 kHz), with a resolution of 0.1 foot. Soundings will be logged at approximately 0.1-second time intervals or at about 2-foot distance intervals along each survey line. The fathometer will be calibrated for water mass sound speed using standard bar check procedures.

Horizontal control for the project will be established from USACE monuments located along the banks of Newark Bay.

Vertical control points will also be obtained from the USACE along with their staging data for tides in Newark Bay. Vertical control information will be shown on drawings and charts produced.

Despite virtually worldwide, 24-hour coverage, technical difficulties with GPS satellites can still occur. In the event of system-wide or other long-term problems with GPS (e.g., satellite failures), survey vessel positioning will be achieved using land-based methods. If a land-based method is selected, an SOP will be developed for its use.

4.4 DECONTAMINATION

Survey and sounding equipment which has been immersed in Newark Bay waters will be decontaminated in accordance with SOP No. 3 - Decontamination.

5.0 QUALITY ASSURANCE

The fathometer and DGPS receivers will be operated and maintained in accordance with the manufacturer's operating manuals. Field instruments will be used by experienced operators familiar with field procedures and manufacturer's instructions.

The vessel-mounted DGPS system performance will be verified daily prior to and after survey activities using a temporary survey point. Vessel position during the bathymetry survey will be checked using computer software (such as Hypack®).

6.0 DOCUMENTATION

The documentation requirements for the field personnel will include recording observations made during profiling that could affect the quality of the data. Complete field documentation procedures are presented in SOP No. 1 – Field Documentation.

In addition, the following information will be recorded in a logbook (at a minimum):

- Survey line number;
- Direction of travel;
- Date;
- Time (EST);
- Time of high tide (EST);
- Profiling equipment (e.g., name and serial number);
- Equipment calibration information;
- Unusual conditions;
- Brief description of the area around the survey line location and the weather conditions at the time of profiling; and
- Description of transect beginning and end-points.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 11

SEDIMENT COLLECTION USING GRAB SAMPLING DEVICE

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for collecting sediment grab samples using a grab sampler (e.g., Van Veen) as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP).

This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to collect grab samples. Specific information regarding grab sampling can be found in the IWP.

This SOP may change, depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 3 – Decontamination;
- SOP No. 5 – Positioning; and
- SOP No. 9 – Management and Disposal of Residuals.

4.0 PROCEDURES

Grab samples may be collected within the Newark Bay Phase I Sediment Investigation (SI) Study Area using a grab sampler in conjunction with the biologically active zone (BAZ) investigation and core collection activities. During the BAZ investigation, three grab samples will be collected from each location occupied for sediment profile imaging (SPI). During core collection activities, grabs sample may be collected adjacent to sediment core collection locations to obtain material for Beryllium-7 (^{7}Be) analysis. Neither of these sampling activities requires chemically-decontaminated sampling equipment.

Following sediment collection for either program, grab samples will be assessed/processed on the coring/sampling vessel. Samples for ^{7}Be will be subsequently transported to the sample processing area for packaging and shipping. Grab sample collecting and processing procedures are described in this SOP.

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- navigation charts and Phase I SI Program Core Locations figure – grab samples will be collected adjacent to core locations (Figure 6-1 of the IWP);
- coring/sampling vessel adequate for Newark Bay conditions;
- marine VHF radio;
- positioning equipment;
- grab samples (e.g., Van Veen);
- winch;
- Daily Activity Log, Grab Sample Collection Form, and BAZ Investigation Form;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices);
- logbooks;
- permanent waterproof marker or grease pencil;
- sample containers;
- stainless steel bowls/buckets or equivalent containers;
- plastic bucket;
- wet ice;
- insulated coolers;
- sample identification labels/tags;
- stainless steel spoons/spatulas;

- tape measure;
- fathometer with a resolution of 0.1 foot;
- camera; and
- decontamination equipment/supplies.

4.2 SAMPLING PROCEDURES

This section gives the step-by-step procedures for collecting grab samples using a grab sampler. Observations made during sediment grab sample collection should be recorded in the Daily Activity Log, Grab Sample Collection Form, and BAZ Investigation Form, and/or a logbook (SOP No. 1 - Field Documentation).

4.2.1 DECONTAMINATION OF EQUIPMENT

The grab sampler, stainless steel bowls/containers, stainless steel spoons/spatulas, and sieves will be cleaned with Newark Bay water in accordance with Section 4.2.3 of SOP No. 3 – Decontamination.

4.2.2 LOCATING POSITION

1. The BAZ or sediment sampling schedule for the day will be established prior to vessel departure, and sufficient equipment to complete the work will be on-board the sampling/coring vessel. Grab samples are anticipated to be collected adjacent to core collection locations where additional sediment volume is needed for ^{7}Be analysis only, and following collection of all SPI images. Prior to departure each day, the vessel crew will be informed of the target sampling locations and the number of grab samples required at each location. In general, three grab samples will be collected at each BAZ location and one grab sample will be collected at each coring location where ^{7}Be analysis is proposed (Section 6 of the IWP).

2. The sampling/coring vessel will move to a BAZ/coring location in accordance with SOP No. 5 - Positioning.

4.2.3 COLLECTION OF GRAB SAMPLES

1. Complete Daily Activity Log.

2. Don PPE as required by RIWP Volume 3 (Tierra, 2005).

3. Secure the grab sampler to a cable of adequate length connected to a winch. In some cases, the grab sampler may be deployed and retrieved manually. Set the device to close upon contact with sediment surface.

4. Slowly lower the grab sampler into its deployment orientation, just above the water surface.

5. Obtain water depth (to nearest 0.1 foot) from the fathometer and record on the Grab Sample Collection Form or BAZ Investigation Form.

6. Slowly lower the grab sampler into the water to the sediment surface using the water depth reading to anticipate when the bottom will be encountered. Allow the device to close, capturing the grab sample.

7. Prior to retrieving the grab, record the final sample location coordinates on the Grab Sample Collection Form or BAZ Investigation Form.

8. Slowly raise the grab sample to the deck of the sampling/coring vessel.

4.2.4 PROCESSING GRAB SAMPLES FOR BAZ INVESTIGATION

1. Release the contents of the grab sample into a plastic bucket. Scrape all sediment from the grab sampler for inclusion in the sample processing.

2. Perform in-field visual examination of sediment texture, sediment color, benthic invertebrate activity, etc., take photographs of sample, and record observations and photograph number in a field logbook.

3. If necessary, remove all large debris (i.e., rocks, leaves, sticks), then pass the entire sediment sample through a standard 500 micron mesh sieve by agitating the sieve in a sieve box containing Bay water to wash away the sediments to view the benthos.

4. Following sample processing, return sample to the Bay.

5. Clean the grab sampler and processing equipment with Newark Bay water in accordance with SOP No. 3 – Decontamination.

4.2.5 PROCESSING GRAB SAMPLES FOR ^{7}Be ANALYSIS

1. Access the sediment from the top of the grab sampler without releasing the contents of the dredge, and scrape the top inch of sediment using a stainless steel spoon/spatula into an appropriate sample container.

2. Appropriately label the sample container with the sample ID, date, and time, and record this information on the Grab Sample Collection Form.

3. Following sample collection, release the remainder of the sediment collected within the grab sampler into the Bay.

4. Clean the grab sampler and processing equipment with Newark Bay water in accordance with SOP No. 3 – Decontamination.

5. Store the sample container in an insulated cooler containing wet ice to keep samples cold while on the vessel until it can be transported to the Sample Processing Area.

5.0 QUALITY ASSURANCE

Completing the Daily Activity Log and BAZ Investigation or Grab Sample Collection Form provided in SOP No. 1 – Field Documentation, will document that the process is being followed and that pertinent information is being collected and recorded in accordance with the procedures outlined in this SOP. Entries in the forms and field logbook will be double-checked by the samplers to verify the information is correct. Completed forms and field logbook will be reviewed periodically by the FC and/or Project Quality Assurance Officer or their designees to verify that the requirements are being met.

6.0 DOCUMENTATION

Field notes will be kept during sampling activities in accordance with SOP No. 1 – Field Documentation. In addition to information contained in the Daily Activity Log and BAZ Investigation or Grab Sample Collection Form, the times of equipment decontamination will be recorded in a logbook.

7.0 REFERENCES

Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan. Volume 3 Health and Safety/Contingency Plan. September.

STANDARD OPERATING PROCEDURE NO. 12

SEDIMENT PROFILE IMAGING

2.0 TABLE OF CONTENTS

3.0 PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedures (SOP) for conducting sediment profile imaging (SPI) to aid in determining the biologically active zone (BAZ) within select geomorphic areas as part of the Newark Bay Study Area Remedial Investigation Work Plan (RIWP). This SOP provides descriptions of equipment, field procedures, laboratory procedures, and documentation necessary to conduct the survey. The objectives and locations of the SPI are discussed in the IWP.

This SOP may change depending on field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Facility Coordinator (FC) (or Alternate FC) and the United States Environmental Protection Agency (USEPA) Remedial Project Manager. The actual procedure employed will be documented in the Newark Bay RI Report.

Other SOPs will be utilized in conjunction with this SOP, including:

- SOP No. 1 – Field Documentation;
- SOP No. 3 – Decontamination;
- SOP No. 5 – Positioning; and
- SOP No. 11 – Sediment Collection Using Grab Sampling Device.

4.0 PROCEDURES

4.1 EQUIPMENT LIST

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required by RIWP Volume 3 (Tierra, 2005);
- navigation charts and Phase I SI Program BAZ and Core Locations figure (Figure 6-1 of the IWP);
- positioning equipment;
- winch;
- assorted nautical equipment (e.g., anchors, lines, personal flotation devices [PFDs]);
- permanent waterproof marker or grease pencil;
- marine VHF radio;
- vessel adequate for Newark Bay conditions;
- Sediment Profile Camera System;
- fathometer with a resolution of 0.1 foot;
- logbook; and
- data storage equipment (e.g., CD).

4.2 PROCEDURES

REMOTS (Remote Ecological Monitoring of the Seafloor) sediment profile imaging is a benthic sampling technique in which a specialized camera is used to obtain undisturbed, vertical cross-section photographs *(in situ* profile) of the upper 15 to 20 cm of the seafloor. This is a reconnaissance survey technique used for rapid collection and interpretation of physical and biological seafloor characteristics.

The Hulcher Sediment Profile Camera System is fitted with a digital camera and a strobe enclosed in a pressure-resistant housing. This housing is mounted in a sturdy aluminum box frame with a hydraulic arm to lower the prism and camera assembly at a 90-degree angle to the sediment. The camera is mounted on top of the prism and aimed down (vertically) at a mirror oriented at 45 degrees to the housing faceplate. The prism is filled with fresh water to prevent distortion of the faceplate in deep water and provide a clear water medium for capturing images. The digital camera is a Minolta Dimage7i that captures a 5.2 mega-pixel image, producing a 14.1 mega-pixel RGB image (JPEG format). The strobe illuminates the sediment allowing for

operation in complete darkness and in turbid water. The aluminum frame allows deployment of the camera in relatively rough seas, as the frame will sit upright on the bottom as long as the downline is slackened when the frame touches the bottom.

The profile camera prism is also fitted with a digital video camera so that video and the digital still camera have the same view of the sediment profile. The video signal is sent to the surface via cable so that prism penetration can be monitored and an initial impression of benthic habitat type can be formed. The video signal will be recorded for future detailed evaluation and review.

SPI will be conducted at 14 locations within the Phase I Sediment Investigation (SI) Study Area. A minimum of two acceptable images will be collected at each location. A preliminary assessment will be made to determine if the images are of acceptable quality while on the sampling vessel. Any unacceptable stations will be resampled.

Three grab samples will be collected at each BAZ location in addition to SPI activities. The grab samples will be collected according to SOP No. 11 – Sediment Collection Using Grab Sampling Device.

4.3 SPI FIELD OPERATIONS

Prior to each field deployment, essential items will be gathered and tested for proper operation. The camera/prism system is mounted in a cradle that is secured to a larger frame that ensures that the prism penetrates the sediment at a 90-degree angle. A winch is used to lower the entire assembly (at a consistent rate) to the seafloor. When the system reaches the seabed the knife-like edge on the bottom of the prism, combined with the camera assembly and additional weights that are added, if necessary, based on the sediment conditions, allows the prism to cut a vertical slice into the sediments. The penetration rate of the camera/prism assembly into the sediment is controlled by a hydraulic piston. The camera can be triggered either by contact with the seabed or manually from the research vessel via the video cable. To permit proper penetration of the sediment by the prism, a brief time delay occurs between contact with the seafloor and the first exposure. The delay ranges from 1 second in soft mud to 15 seconds in hard sand. The camera can be set to take a series of images at about 1.5-second intervals during penetration or triggered multiple times from the surface. After the required number of exposures, including several exposures after full penetration, the camera assembly is retrieved to the ship or repositioned for additional images. The quality of the images can be monitored via the video link to the surface. Any unacceptable replicates are resampled in real time while still on station. On deck, the images are transferred from the microdrive in the camera to a computer and then to a CD for more permanent storage. The images are also reviewed in high resolution to ensure they are acceptable.

4.4 CALIBRATION PROCEDURES AND PREVENTATIVE MAINTENANCE

Prior to each field deployment, video components are tested for proper operation. Once the SPI system is assembled on board the research vessel, a system check is initiated that includes all features of the SPI system. In addition, before each field deployment, the clock in the SPI system will be set to match the clock used by the navigation system aboard the research vessel.

4.5 DECONTAMINATION

SPI equipment which has been immersed in Newark Bay sediments/waters will be decontaminated in accordance with SOP No. 3 - Decontamination.

4.6 IMAGE PROCESSING AND ANALYSIS

4.6.1 GENERAL APPROACH

Computer images will be analyzed using a Power Macintosh microcomputer and NIH Image, the National Institute of Health's image analysis program. Computer analysis procedures for each image are standardized by executing a series of macro commands. Data generated from each image analyzed are saved sequentially to an ASCII file for additional analysis and reduction using Microsoft Excel™.

The actual image analysis is done through a series of macro commands executed from a video screen menu. After each step, the analyst is asked if the results are satisfactory and given the chance to redo any step. During the image analysis session, two computer files are opened to receive data from each image. One file includes all computer-executed statements and the resultant data. This file is archived and can be accessed should any questions arise as to how the analysis of any particular image was conducted. A second file, that includes only the selected image data to be used in reports, is generated at the same time. After computer analysis, the images are put into the SPI photo archives for future reference.

4.6.2 SPECIFIC APPROACH

The following parameters are evaluated and documented for each location.

Prism penetration provides a geotechnical estimate of sediment compaction, with the profile camera prism acting as a dead weight penetrometer. The farther the prism enters into the sediment, the softer the sediment and likely the higher the water content. Penetration is measured simply as the distance the sediment moves up the length of the faceplate. If the weight of the

camera frame is not changed during field image collection, then the prism penetration provides a means for assessing the relative sediment compaction between stations or different habitat types.

Surface relief is measured as the difference between the maximum and minimum distance the prism penetrates. This parameter provides an estimate of small-scale bed roughness, on the order of the prism faceplate width (16 cm). The causes of roughness often can be determined from a visual analysis of the images.

Apparent color redox potential discontinuity (RPD) layer is an important estimator of benthic habitat quality. It is the depth to which sediments are oxidized. The term "apparent" is used in describing this parameter because no actual measurement is made of the redox potential. An assumption is made that, given the complexities of iron and sulfate reduction-oxidation chemistry, reddish-brown sediment color tones are indications that the sediments are oxic (oxidized), or at least are not intensely reducing. This is in accordance with the classical concept of RPD depth, which associates it with sediment color. The depth of the apparent color RPD is defined as the area of all the pixels in the image discerned as being oxidized divided by the width of the digitized image. The area of the image with oxic sediment is obtained by digitally manipulating the image to enhance characteristics associated with oxic sediment (greenish-brown color tones). The enhanced area is then determined from a density slice of the image or, if image quality is poor, the area is delineated with the cursor.

Sediment grain size is a geotechnical feature of the sediment that is used to determine the type of sediment present. The nature of the physical forces acting on a habitat can be inferred from grain-size distribution of the sediments. The sediment type descriptors that are used follow the Wentworth classification as described in Folk (1974) and represent the major modal class for each layer identified in an image. Sediment grain size is determined by comparing the collected images with a set of standardized images taken of sediments for which mean grain size has been determined by laboratory analyses. Sediment grain sizes ranging from pebble/rock to gravel, sand, silt, and clay can be estimated accurately from the images.

Surface features include a variety of physical and biological features that can be seen at or on the sediment surface. These include SAV, worm tubes, fecal pellets, epibenthic organisms, bacterial mats, algal mats, shells, mud clasts, bed forms, feeding pits, and mounds. Each feature provides information on the type of habitat and its quality. Certain surface features are indicative of the overall nature of a habitat. For example, bed forms are always associated with physically dominated habitats; whereas, worm tubes or feeding pits are indicative of a more biologically accommodated habitat. Surface features are visually evaluated from each slide and compiled by type and frequency of occurrence.

Subsurface features include a variety of features such as burrows, water-filled voids, SAV rhizomes, infaunal organisms, gas voids, shell debris, detrital layers, and sediment lenses of different grain size. Subsurface features also reveal a great deal about the physical-biological control occurring in a habitat.

Successional stages of the fauna in a habitat can be estimated using SPI data. Characteristics that are associated with pioneering or colonizing (Stage I) assemblages, such as dense aggregations of small polychaete tubes at the surface and shallow apparent RPD layers, are seen in sediment profile images. Advanced or equilibrium (Stage III) assemblages also have characteristics that are seen in profile images, such as deep apparent RPD layers and subsurface feeding voids.

5.0 QUALITY ASSURANCE

The data quality objectives for the field collection of the SPI will be met by following several procedures. Proper assembly and operation of the SPI system will ensure that the digital still images obtained are clear and of high quality. Prior to each field deployment, SPI components are tested for proper operation. Once the SPI system is assembled on board the research vessel, a system check is initiated that includes all features of the SPI system. Proper system functioning (penetration of prism, flash from SPI camera) will be monitored with test images taken on deck.

To ensure that the required images are collected, the camera image counter will be checked to confirm that the system was functioning properly after every station or replicate deployment. Any mis-fires or improper camera operation will be corrected while on station. Almost any electronic or mechanical failure of the profile camera can be repaired in the field. Spare parts and a complete back-up camera will be carried on each SPI survey. Images will be collected at the required stations.

6.0 DOCUMENTATION

The documentation requirements for the field personnel will include recording observations made during SPI activities that could affect the quality of the data. Complete field documentation procedures are presented in SOP No. 1 – Field Documentation.

In addition, the following information will be recorded in a logbook (at a minimum):

- SPI location ID;
- Date;
- Time (EST);
- Profiling equipment (e.g., name and serial number);
- Equipment calibration information;
- Unusual conditions;
- Names of the members of the SPI/BAZ crew; and
- Number of SPI images attempted and collected.